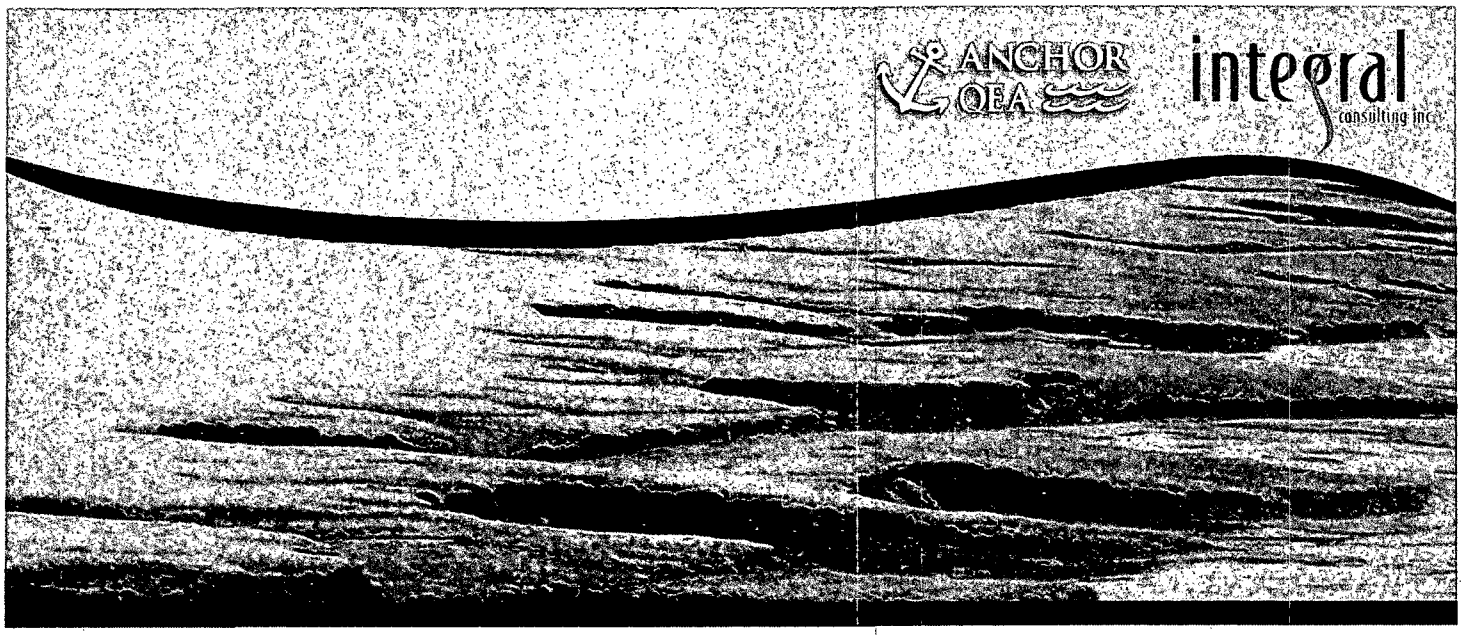

SAMPLING AND ANALYSIS PLAN: TCRA CAP POREWATER ASSESSMENT SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

Prepared for

McGinnes Industrial Maintenance Corporation
International Paper Company
U.S. Environmental Protection Agency, Region 6

Prepared by

Integral Consulting Inc.
411 First Avenue South, Suite 550
Seattle, Washington 98104

Anchor QEA, LLC
614 Magnolia Avenue
Ocean Springs, Mississippi 39564

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Title and Approval Sheet

Quality Assurance Project Plan Approvals

EPA Remedial Project Manager:	Gary Miller	_____	Date: _____
EPA Quality Assurance (QA) Reviewer:	Walter Helmick	_____	Date: _____
Respondents' Project Coordinator and Anchor QEA Project Manager:	David Keith	_____	Date: _____
Integral Project Manager:	Jennifer Sampson	_____	Date: _____
Laboratory QA Coordinator:	Craig Hutchings	_____	Date: _____
Chemical Laboratory Project Manager (CAS Kelso):	Greg Salata	_____	Date: _____
Chemical Laboratory QA Manager (CAS Kelso):	Julie Gish	_____	Date: _____
SPME Laboratory Manager	Daniel Reible	_____	Date: _____

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

LIST OF ACRONYMS AND ABBREVIATIONS

Anchor QEA	Anchor QEA, LLC
COC	chain-of-custody
COPC	chemical of potential concern
CLP	Contract Laboratory Program
CSM	conceptual site model
DQO	Data Quality Objective
EDD	electronic data deliverable
EDL	estimated detection limit
FSP	Field Sampling Plan
HASP	Health and Safety Plan
I-10	Interstate Highway 10
Integral	Integral Consulting Inc.
IPC	International Paper Company
MIMC	McGinnes Industrial Maintenance Corporation
MDL	method detection limit
MRL	method reporting limit
OMM	operations monitoring and maintenance
PARCC	precision, accuracy or bias, representativeness, completeness, comparability
PCDD	polychlorinated dibenzo-*p*-dioxin
PCDF	polychlorinated dibenzofuran
PDMS	polydimethylsiloxane
PRC	performance reference compound
PSCR	Preliminary Site Characterization Report
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI/FS	Remedial Investigation and Feasibility Study
RPD	relative percent difference
SAP	Sampling and Analysis Plan

Site	San Jacinto River Waste Pits Superfund site
SJRWP	San Jacinto River Waste Pits
SPME	solid-phase microextraction
SOP	standard operating procedure
SRM	Standard Reference Material
TCDD	tetrachlorodibenzo-*p*-dioxin
TCDF	tetrachlorodibenzofuran
TCRA	time critical removal action
UAO	Unilateral Administrative Order
USEPA	U.S. Environmental Protection Agency
UT	University of Texas

1 PROJECT MANAGEMENT

1.1 Distribution List

Title	Name
EPA Remedial Project Manager	Gary Miller
EPA QA Reviewer	Walter Helmick
Respondents' Project Coordinator and Anchor QEA Project Manager	David Keith
McGinnes Industrial Maintenance Corp. Project Manager	David Moreira
International Paper Co. Project Manager	Philip Slowiak
Integral Project Manager	Jennifer Sampson
Laboratory QA Coordinator	Craig Hutchings
Database Administrator	Dreas Nielsen
Chemical Testing Laboratory Project Manager	Greg Salata
Chemical Testing Laboratory QA Manager	Julie Gish
SPME Laboratory Manager	Danny Reible

1.2 Introduction and Task Organization

This Sampling and Analysis Plan (SAP) has been prepared on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC), pursuant to the Remedial Investigation and Feasibility Study (RI/FS) required by Unilateral Administrative Order (UAO), Docket No. 06-03-10, which was issued by the U.S. Environmental Protection Agency (USEPA) to IPC and MIMC on November 20, 2009 (USEPA 2009a). The 2009 UAO directs IPC and MIMC to conduct an RI/FS for the San Jacinto River Waste Pits (SJRWP) Superfund Site in Harris County, Texas (the Site). The Site consists of a set of impoundments, built in the mid-1960s for disposal of paper mill wastes, and the surrounding areas containing sediments and soils potentially contaminated with the waste materials that had been disposed of in the impoundments.[1] A set of impoundments approximately 14 acres in size is located on a 20-acre parcel, immediately north of the Interstate Highway 10 (I-10)

[1] USEPA has identified an area south of I-10 as the location of an additional impoundment that USEPA has identified as having been used for disposal of paper mill wastes in the 1960s, or Soil Investigation Area 4 (Integral 2011a). This document does not address Soil Investigation Area 4 at all, and data collections described by this SAP will not be conducted there.

Bridge over the San Jacinto River and on the river's western bank (Figure 1-1). This study addresses only the impoundments situated north of I-10.

Concurrent with the RI/FS, a time critical removal action (TCRA) was implemented by IPC and MIMC under an Administrative Order on Consent with USEPA (Docket No. 06-12-10, May 2010; USEPA 2010). The purpose of the TCRA was to stabilize the entire area within the original perimeter of the impoundments north of I-10, to abate any release of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) and other chemicals of potential concern (COPCs) into the waterway from the waste in these impoundments until the Site is fully characterized and a final remedy is selected (USEPA 2010).

This SAP addresses sampling and analyses required to evaluate the effectiveness of the TCRA cap in containing COPCs and controlling releases from the impoundments to the environment. The objective is to develop information that can be used to evaluate performance of the TCRA cap in preventing the release of dissolved phase dioxins and furans from the area within the 1966 perimeter of the northern impoundments. The study, to be conducted as a task under the UAO (USEPA 2009a) as directed by USEPA, employs solid-phase microextraction (SPME) porewater samplers as developed by Dr. Danny Reible at the University of Texas (UT) (e.g., Lu et al. 2011) and others (Mayer et al. 2000) to assess the chemistry of porewater within the TCRA cap. The result of this study will be an approximation of the porewater concentrations of the target chemical at the locations of each sampler. The method is expected to neither underestimate nor overestimate the concentration in the porewater; details describing the analytical approach and the specific results of this study are described in the data quality objectives (DQOs), in Section 1.6.

This document presents the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP), which is included as Appendix A. The QAPP was prepared consistent with USEPA guidance and requirements for QAPPs (USEPA 1998, 2001), as required by the 2009 UAO. The organizational structure for implementation of this project is illustrated in Figure 1-2. Contact information for key personnel is provided in Section 1.3.

1.3 Project Organization

IPC and MIMC have retained Anchor QEA, LLC (Anchor QEA), Integral Consulting Inc. (Integral), and Dr. Reible to perform the TCRA cap porewater assessment study. Figure 1-2 illustrates the organization of personnel on the project. The primary contacts for USEPA, MIMC, and IPC are provided in the following table. A description of the project organization and contacts pertaining to this QAPP are provided after the table.

USEPA and Respondent Project Managers

Title	Name	Contact Information
USEPA Remedial Project Manager	Gary Miller	U.S. Environmental Protection Agency, Region 6 1445 Ross Avenue Dallas, TX 75202-2773 (214) 665-8318 miller.garyg@epa.gov
McGinnes Industrial Maintenance Corporation Project Manager	David Moreira	4 Liberty Lane West Hampton, NH 03842 603.929.5446 dmoreira@wm.com
International Paper Company Project Manager	Philip Slowiak	6400 Poplar Avenue Memphis, TN 38197-0001 (901) 419-3845 philip.slowiak@ipaper.com

The TCRA cap porewater assessment study is organized into two study elements, as described in Section 1.6. These correspond to the broader Study Elements 1 through 4 described in the RI/FS Work Plan. Study Element 1, *Nature and Extent Evaluation*, and Study Element 2, *Exposure Evaluation,* do not apply to the TCRA cap porewater assessment study. To execute this study, Anchor QEA and Integral will conduct the fieldwork and data analysis. The names and quality assurance (QA) responsibilities of key project personnel for Anchor QEA and Integral who will be involved in sampling and analysis activities are provided below.

Project Personnel Quality Assurance Responsibilities

Title	Responsibility	Name	Contact Information
Project Coordinator	Coordination of project information and related communications on behalf of IPC and MIMC with USEPA; liaison between USEPA project managers and respondent project managers	David Keith	Anchor QEA, LLC 614 Magnolia Avenue Ocean Springs, MS 39564 (228) 818-9626 dkeith@anchorqea.com
Anchor QEA Project Manager	Project planning and implementation; liaison between respective internal and external team members and project coordinator	David Keith	Anchor QEA, LLC 614 Magnolia Avenue Ocean Springs, MS 39564 (228) 818-9626 dkeith@anchorqea.com
Integral Project Manager	Responsible for the successful completion of tasks associated with Study Elements 1 and 2 and coordination with the Anchor QEA project manager, the IPC project manager, and the MIMC project manager to execute the study described in this SAP	Jennifer Sampson	Integral Consulting Inc. 411 1st Avenue South Suite 550 Seattle, WA 98104 (206) 957-0351 jsampson@integral-corp.com
Anchor QEA and Integral Corporate Health and Safety Managers	Oversight of health and safety program for field tasks associated with RI/FS	David Templeton	Anchor QEA, LLC 1423 Third Avenue, Suite 300 Seattle, WA 98101 (206) 287-9130 dtempleton@anchorqea.com
Project Database Administrator Integral	Database development and data management	Dreas Nielsen	Integral Consulting Inc. 411 1st Avenue South Suite 550 Seattle, WA 98104 (206) 957-0311 dnielsen@integral-corp.com
Laboratory QA Coordinator	Completeness of QA documentation and procedures; liaison between project personnel, chemical testing laboratories, and data validators and for related QA communications with USEPA	Craig Hutchings	Integral Consulting Inc. 1205 West Bay Dr. NW Olympia, WA 98502 (360) 705-3534 chutchings@integral-corp.com

1.3.1 SPME Laboratory

This project includes the use of a laboratory at UT to prepare the sampling equipment. The following are the responsibilities of the representative of the laboratory preparing the SPME samplers and polydimethylsiloxane (PDMS)-coated fibers for sampling:

- Ensure that sampling devices and SPME fibers are cleaned and prepared according to the standard operating procedures (SOPs; Appendix A, Attachment A2).
- Oversee the deployment, retrieval, and processing of the SPME samplers.
- Notify the task QA coordinator if problems occur in sampler preparation, deployment, retrieval, or processing.
- Take appropriate corrective action as necessary.

1.3.2 Analytical Laboratory

The analytical laboratory project manager is responsible for the successful and timely completion of sample analyses, and for performing the following tasks:

- Ensure that samples are received and logged in correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times.
- Review analytical data to ensure that procedures were followed as required in this QAPP, the cited methods, and laboratory SOPs.
- Keep the task QA coordinator apprised of the schedule and status of sample analyses and data package preparation.
- Notify the task QA coordinator if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met.
- Take appropriate corrective action as necessary.
- Report data and supporting QA information as specified in this QAPP.

The analytical laboratory QA manager is responsible for overseeing the QA activities in the laboratory and ensuring the quality of the data for this project. Specific responsibilities include the following:

- Oversee and implement the laboratory's QA program.
- Maintain QA records for each laboratory production unit.

- Ensure that QA and quality control (QC) procedures are implemented as required for each method and provide oversight of QA/QC practices and procedures.
- Review and address or approve nonconformity and corrective action reports.
- Coordinate response to any QC issues that affect this project with the laboratory project manager.

1.4 Problem Definition and Background

Background information on the northern impoundments has been provided in earlier publications that have been approved by USEPA. The RI/FS Work Plan (Anchor QEA and Integral 2010) describes the Site history for the area north of I-10, the four study elements addressed by each study conducted for the remedial investigation, and the overall process leading to selection of a remedy. The Preliminary Site Characterization Report (PSCR) (Integral and Anchor QEA 2012) uses results of the remedial investigation studies to describe the Site physical setting, identify data gaps, and update the conceptual site model (CSM) for the area north of I-10 and surrounding aquatic environment. That information is not repeated here. This section highlights the background information that specifically informs the objectives and design of this study, including a description of the TCRA cap, a summary of the baseline data for groundwater collected from within the original 1966 perimeter of the northern impoundments, and the rationale supporting the use of dioxins and furans as the indicator chemical group for the RI/FS. The result is a statement of the problem to be addressed by the study, which is a key component in defining the DQOs.

Subsequent sections of this document provide a general task description and the complete DQOs; a design for the collection and analysis of new information to address and reduce uncertainties; and the sampling procedures, sample custody, analytical procedures, data validation, reporting and management, and QA procedures. Appendix A, the FSP, describes in detail the sampling and data gathering methods, station positioning, field documentation, and all sample handling details. It includes field SOPs and an addendum specific to this study for the project Health and Safety Plan (HASP; Anchor QEA 2009). Appendix B provides an addendum to the laboratory SOPs.

1.4.1 Description of the TCRA and Cap

To design the sediment cap required for the TCRA, the area within the original 1966 perimeter was separated into three distinct areas: 1) the eastern cell, 2) the western cell, and 3) the northwestern area (Figure 1-3). The construction elements of the TCRA included:

- Installation of a stabilizing geotextile underlayment over the eastern cell
  - The permittivity of the geotextile underlayment is 1.0 per second, and the apparent opening size is 0.15 mm.
- Installation of an impervious geomembrane underlayment between an underlying and overlying layer of geotextile in the western cell
- Installation of granular cover above the geotextile and geomembrane in the western cell, and above the geotextile in the eastern cell
- Installation of a granular cover in the northwestern area where the slope of the river bottom did not allow for placement of the geotextile underlayment.

Four different armor rock gradations were specified for the cap material. The armor cap layout is provided in Figure 1-3. Each of the armor rock types and minimum thicknesses are provided in Table 1-1, along with the final in-place quantities for each type.

Prior to geotextile, geomembrane, and armor rock installation in the western cell, the low-lying areas were stabilized using an 8 percent by weight Portland cement admixture. A total of 430 tons of Portland cement was used to complete the stabilization. The surface was then graded and received three geosynthetic layers: 12-ounce geotextile; 40-mil linear low density polyethylene geomembrane; and 16-ounce geotextile.

The total quantities of geotextile and geomembrane installed during the TCRA are 79,000 square yards (sy) and 15,400 sy, respectively.

Aerial images of the affected area before and after construction on July 14, 2011, are shown in Figure 1-4.

1.4.2 Summary of Groundwater Data

Chemicals associated with the waste impoundments are expected to be exclusively those associated with solid wastes produced by bleached kraft pulp mill operations (Section 1.5 of the Sediment SAP). Chemistry data for groundwater, sediment, and soil collected from within the area of the impoundments show that PCDDs and PCDFs are present in soil and sediments in and near the impoundments at concentrations higher than other Site and regional samples.

As described in the PSCR (Integral and Anchor QEA 2012), a groundwater investigation was conducted in which three well pairs were installed at points surrounding the impoundments north of I-10, with one shallow and one deep well in each pair. The shallow wells in each well pair were constructed with screened intervals in alluvial sediments in zones of relatively greater permeability. The deep wells in each well pair were constructed with the screened interval immediately below the Beaumont clay. Screened intervals in both shallow and deep well groups are approximately the same length and elevation. One additional well, SJMWS04, was completed within impoundment waste at the request of USEPA, and results reflect the condition of perched water within the waste. The groundwater study resulted in a set of groundwater samples collected from the wells and analyzed for dioxins and furans, other chemicals of potential concern and conventional analytes.

Results from the three well pairs that were installed at points surrounding the impoundments indicate that shallow alluvial and deeper groundwater quality beneath the impoundments north of I-10 is in compliance with the most applicable state standards for all chemical analytes (Table 1-2). Dioxin and furan concentrations are either below detection limits, with detection limits below the TCEQ and USEPA standards identified in DQOs for the groundwater study, or estimated at concentrations below limits for groundwater of this type or for drinking water (Table 1-2). 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) was not detected in alluvial groundwater nor in groundwater from the aquifer below the Site. OCDD and 2,3,7,8-tetrachlorodibenzofuran (TCDF) were estimated (i.e., below reporting limits) in one alluvial groundwater sample, all other dioxin and furan congeners were not detected in alluvial and deep groundwater samples.

Some dioxin and furan congeners were reported in the sample of perched water taken from the monitoring well constructed within the waste and screened in the top 2.5 feet of waste material. The perched water sample from inside the western impoundment had a 2,3,7,8-TCDD concentration of 2,700 pg/L. Whether the detected congeners were dissolved or associated with particulates or other materials in the sample is unknown. As a result, it is unknown whether dissolved dioxins and furans occur in perched water within the waste or were transported to surface water under past conditions. This uncertainty was identified as a data gap by USEPA in comments on the draft PSCR and is indicated as a data gap in the final PSCR. This porewater assessment study is being conducted to address this data gap. However, uncertainties about whether porewater to surface water transport from the wastes in the impoundment north of I-10 occurred in the past cannot be addressed, because the Site conditions, as affected by implementation of the TCRA (Figure 1-4), do not allow for a study to evaluate this question. The current study will provide information that will allow assessment of the potential for transport of dissolved dioxins and furans from waste materials through a porewater to surface water pathway under existing conditions.

1.4.3 Dioxins and Furans as an Indicator Chemical Group

Dioxins and furans are the indicator chemical group for the RI/FS (Anchor QEA and Integral 2010). Their concentrations in sediment and soil samples from within the impoundments are high relative to background. Further, the degree to which they exceed risk-based screening levels in these sediments relative to those of the other COPCs is also high, indicating that they are very likely to be the most important risk driver at the Site. For these reasons, dioxins and furans are the chemicals of greatest concern to the RI/FS. The specific uses of dioxins and furans as an indicator chemical group for TCRA cap porewater assessment are discussed in sections below.

1.4.4 Problem Definition and Overall CSM

The 2009 UAO required that a remedial investigation be conducted at the Site, and the remedial investigation was initiated in December, 2009. The TCRA was implemented from late 2010 through July 2011 at the Site to stabilize wastes within the area of the original impoundments north of I-10, independent of the remedial investigation. Several studies to

define the baseline conditions for risk evaluation, and to otherwise support the remedial investigation, were conducted prior to or during the TCRA construction, and resulting data were reported in the PSCR (Integral and Anchor QEA 2012). Studies supporting the remedial investigation have generated data to describe the baseline (pre-TCRA) conditions, as appropriate for the purposes of the remedial investigation, and resulted in an update to the CSM for the area north of I-10 and surrounding aquatic environment (Figure 1-5). In the context of the updated CSM, the PSCR also identifies uncertainties and data gaps that require new information prior to preparation of the Remedial Investigation Report. In comments on the groundwater study described in the draft PSCR, USEPA indicated that additional information is needed to address uncertainties about the potential for transport of dioxins and furans detected in perched water within the waste into surface water, because if this is occurring, it would result in a complete exposure pathway to human and ecological receptors.

Implementation of the TCRA included the design and construction of a cap over the entire area within the original 1966 northern impoundment perimeter. The TCRA was intended to stabilize the waste material in the impoundments, restrict public access, and prevent the release of waste-related chemicals into the environment of the Site. Cap construction was completed in July 2011, shortly before publication of the draft PSCR. Consequently, the baseline condition described by the remedial investigation dataset no longer exists; baseline conditions have been significantly affected by implementation of the TCRA. Nevertheless, the results of this study are needed for the remedial investigation to address uncertainty about the porewater-to-surface water pathway identified by USEPA comments on the PSCR (Comments 31 and 32). Study results will reflect current (post-TCRA) conditions. The investigation described in this SAP will also address the effectiveness of the cap in achieving its purpose of abating any releases of waste-related COPCs to the environment. All of the resulting information will inform evaluation of remedial alternatives in the feasibility study.

1.5 Task Description

This study will address data gaps identified by USEPA comments on the PSCR by generating new data to describe the chemistry of porewater in TCRA cap. It consists of a series of tasks,

to be executed by Integral and Anchor QEA on behalf of Respondents and in consultation with USEPA:

- Agreement on the study design and finalization and USEPA approval of a complete cap porewater assessment study SAP
- Preparation of sampling equipment
- Fieldwork to deploy and retrieve sampling equipment, and appropriate execution of contingency plans as needed for conditions in the field
- Effective communication of any necessary modifications to the SAP occurring during the study, a consensus view of the means to address required changes, and employment of contingencies and alternatives identified during the sampling process
- Effective processing, handling, shipment, and analyses of samples, all of which conform to specifications of this SAP
- Complete documentation of sample collection, deviations from the SAP, field activities and observations, sample processing and shipping, chain of custody requirements, and analytical procedures
- Validation of resulting chemistry data according to specifications in this SAP
- Complete and timely loading of validated data into the project database, and dissemination of the data to USEPA and interested parties.

The TCRA cap porewater assessment study will generate new information organized into two related study elements, which correspond to the broader Study Elements 3 and 4 as described in the RI/FS Work Plan:

- Study Element 3: Physical CSM and Fate and Transport Evaluation
- Study Element 4: Engineering Construction Evaluation.

Results of the study will address Study Element 3 (as described in this document) by reducing uncertainty identified by USEPA in comments on the draft PSCR regarding the potential for transport of contaminants from porewater to surface water. Results will be used to update the CSM in the Remedial Investigation Report. Data generated by this study will be used to address Study Element 4 by supporting evaluation of remedial alternatives that incorporate the TCRA cap into the final remedy. Such evaluations will occur in the feasibility study.

DQOs for each element as they pertain to the area affected by the cap are discussed in Section 1.6. The study design is described in greater detail in Section 2.1. Analytes for all samples generated by this study include dioxins and furans.

This study will take place in the second and third quarters of 2012 (Anchor QEA and Integral 2010), unless other agreements regarding the sampling period are made in consultation with USEPA.

1.6 Data Quality Objectives and Criteria

This section presents a summary of the DQOs for each of the two study elements of the TCRA cap porewater assessment study described by this SAP, prepared consistent with USEPA guidance (USEPA 2006). Establishing DQOs for each study element provides assurance that sampling will be focused on the goals of the RI/FS and will be sufficient to address those goals. The DQO summaries in the following subsections include, for each study element, a statement of the problem, a description of the analytical or interpretive approach to be followed, and components of the sampling design necessary to support the analytical or interpretive approach.

1.6.1 DQOs for Study Element 3: Physical CSM and Fate and Transport Evaluation

The RI/FS is being undertaken to address contamination of San Jacinto River sediments in the vicinity of the impoundments, and to prepare for remedial action if appropriate. Information on the mechanisms and pathways of release and transport of Site-related contaminants is necessary for a complete and accurate CSM, which is used to inform the evaluation of remedial alternatives.

1.6.1.1 Statement of the Problem

Information to address uncertainties regarding the release of COPCs, as indicated by dioxins and furans, is necessary to address uncertainties in the CSM (Study Element 3).

The immediate information needs that will be addressed by Study Element 3 of the cap porewater assessment study is a determination of whether vertical gradients in concentrations of dioxins and furans in porewater of the cap exist, and whether porewater concentrations in the cap differ from concentrations in surface water above the cap.

1.6.1.2 Analytical Approach

Concentrations of 2,3,7,8-TCDD and 2,3,7,8-TCDF in porewater and surface water will be approximated using information collected with SPME fibers. These two congeners were chosen because they are known to be associated with the pulp waste at the northern impoundments (e.g., Table 9, Integral 2011b), and they are the most significant contributors to total TEQ concentrations in sediments within the area of the impoundments. Both are hydrophobic with similar estimated ranges of octanol–water partition coefficients (Table 1-3). Deployment of SPME fibers into the sediment matrix is an equilibrium extraction technique used to sense dissolved concentrations of hydrophobic organic compounds in porewater, and which does not require prohibitively large volumes of porewater for analysis (Mayer et al. 2000). SPME samplers will be used to approximate concentrations of TCDD and TCDF in the porewater of the cap in armor types A, B/C, C, and D (Figure 1-6). Three discrete samples will be collected at each sampling location to provide a vertical profile of TCDD and TCDF through the cap at that location. The vertical samples will be taken in 5 cm increments just above the geotextile fabric, midway between the fabric and the surface of the cap, and just below the interface of the cap material and the surface water (Figure 1-7). The use of 5 cm increments as the sample unit was selected to balance the analytical sensitivity, which is greater with greater sample mass (a function of the increment length), against the need to estimate porewater concentrations at discrete points within the vertical dimension at each sampling point.

Because the depth of armor rock varies (Figure 1-8), the vertical distance between fiber samples within any given sampling location may vary (Figure 1-7). In two locations, the SPME sampler for the location will include an additional SPME fiber attached to the portion of the sampler extending above the surface of the cap, and a 5 cm sample from the fiber exposed to surface water will be used to obtain an approximation of TCDD and TCDF concentrations in surface water (Figure 1-7). Two surface water sampling locations are

deemed sufficient because the overlying surface water in the San Jacinto River is expected to be well mixed and average concentrations for TCDD and TCDF in the surface water are expected to be consistent throughout the area. SPME sampling devices from which the three vertical porewater measurements are made will be deployed in 14 locations within the submerged portions of the cap (Figure 1-9).

In addition to the SPME sampler deployed at each sampling location, four samplers will be deployed containing a fiber impregnated with performance reference compounds (PRCs). The PRCs for this study will be carbon-13 ($^{13}C_{12}$)-labeled TCDD and TCDF. Samplers containing PRC-impregnated fibers are included to provide information necessary to ensure that sample fibers have reached equilibrium with the porewater or surface water at the time of retrieval, or to enable calculation of the equilibrium concentration of each congener (discussed below). Because the PRCs are the same as the target chemicals, except for the $^{13}C_{12}$ label, the samplers with the fibers need to be positioned in separate sampling devices, and placed separate, unique locations substantially separated from any sampling location (Figure 1-9). The chemical transport processes that may affect the time to reach equilibrium in each armor cap type will be similar because the nature and thickness of those materials are similar among the cap types, and because tidal fluctuations, which will affect all areas of the cap in the same way, are expected to be a significant factor in the equilibration of the PDMS with the surrounding porewater. There are four primary armor cap types in the submerged portion of the cap; therefore, one PRC sampler will be placed in each of the four submerged cap types to evaluate equilibrium conditions in those areas. There is a fifth cap type, Armor Cap D_{24}, that was placed in areas above the normal waterline on the central and southern berm, and in a small intertidal area north of the central berm. Because most of Armor Cap D_{24} is not normally below the waterline, the other portion is relatively small compared to other cap types, and it represents the thickest section of cap compared to the other cap types, it is not being specifically targeted for sampling as part of this study.

The resulting approximate porewater concentrations (as discussed below) in each sample will be compared within the sampling location to determine whether a vertical concentration gradient is present in that location, its direction, and the strength of the gradient. The result

will allow assessment of the presence and direction, or the absence, of a vertical concentration gradient in TCDD and TCDF at each sampling location.

There will be four sampling locations in areas of the cap with armor cap A, one within armor cap B, five sampling locations in areas of the cap with armor cap C, and four sampling locations in areas of the cap with armor cap D (18-inch design thickness) (Figure 1-9). Samples from armor cap types C and D will include a sample interval in the surface water above the cap.

1.6.1.3 Sample Collection Design

SPMEs are glass fibers coated with PDMS, a strong polymer sorbent, which will absorb any dioxin and furan congeners (as well as other hydrophobic organic compounds) present in dissolved form in the porewater of the cap, or in surface water above the cap if the polymer-coated fiber is deployed into surface water. To employ SPME technology for this study, a sampling device containing an SPME fiber is inserted into the cap material at each sampling station, the device is left in place for approximately 30 days to allow TCDD and TCDF dissolved in porewater to reach their equilibrium distribution between the sediment matrix and the PDMS, and the resulting mass (picograms) of TCDD and TCDF in the volume of PDMS on the fiber sample is measured. The concentration of TCDD or TCDF in the PDMS (C_{PDMS}, pg/L) is calculated as the mass of TCDD or TCDF (picograms) divided by the product of the length of the fiber sample (i.e., 5 cm or 0.05 m) and volume of PDMS per meter of fiber (L/m). The fibers that will be used in this study will be 1,000-µm-diameter fibers with a 35-µm coating of PDMS, which corresponds to about 115.5 µL (or 0.0001155 L) of PDMS per meter of fiber. The length of each sample will be approximately 5 cm, but will be measured precisely at the time of sampler processing (see the SPME Method in Attachment A2 of the FSP). This sample length was selected to provide the lowest possible minimum detection limit for the target compounds, while still sampling a discrete interval in the vertical dimension of the cap at each sampling location.

Following calculation of C_{PDMS}, porewater concentrations are estimated as described below. For example, with an estimated detection limit for TCDD of 1.31 pg (see Section 2.5), the minimum concentration of TCDD in porewater that can be estimated using the K_{OW} value

from Grovers and Krop (1998) of 1 x $10^{6.96}$ and the fiber specifications above will be 0.025 pg/L. This analytical sensitivity is sufficient for perceiving vertical gradients in porewater concentrations of TCDD within a sampling location, if they exist. Uptake of each congener into the polymer is described by a PDMS–water partitioning coefficient, or $K_{P\text{-}W}$. Using the congener-specific $K_{P\text{-}W}$, the dissolved porewater concentrations can be derived as (Mayer et al. 2000):

$$C_{PW} = C_{PDMS}/K_{P\text{-}W} \qquad \text{(Eq. 1)}$$

Where:

C_{PW}	=	concentration in porewater (pg/L)
C_{PDMS}	=	concentration in the PDMS coating on the fiber (pg/L)
$K_{P\text{-}W}$	=	PDMS–water partitioning coefficient (L/L)

Unless congener specific $K_{P\text{-}W}$ values are available from other publications, or are measured using a site-specific bench-scale study, then the $K_{P\text{-}W}$ value in the equation above is substituted with the published, congener-specific octanol–water partitioning coefficient (K_{OW}). The K_{OW} is then used to estimate the concentration of each congener in porewater from the C_{PDMS}. Because the K_{OW} is not equal to the $K_{P\text{-}W}$ (e.g., Lu et al. 2011; Mayer et al. 2000), the resulting C_{PW} cannot be interpreted as an estimate of the actual porewater concentration. In a study comparing measured $K_{P\text{-}W}$ values with K_{OW} values for five PCB congeners (Lu et al. 2011), the measured $K_{P\text{-}W}$ for all five PCB congeners were similar to but consistently slightly lower than the K_{OW} values. This would suggest that using a K_{OW} value as a substitute for the $K_{P\text{-}W}$ for these PCB congeners in the equation above would result in a slight underestimate of the actual porewater concentration of the PCB congener. No study is available to compare the K_{OW} and $K_{P\text{-}W}$ values for TCDD and TCDF, so whether the approximate porewater concentrations of TCDD and TCDF will be above or below the actual concentration is unknown. The study by Lu et al. (2011) suggests that use of the K_{OW} to substitute $K_{P\text{-}W}$ in Equation 1 will provide a reasonable approximation of the actual porewater concentrations.

More importantly to the study objectives, this sampling method does provide a means to approximate the porewater concentration in a manner allowing comparison between samples, and results are suitable for establishing the absence or the presence and nature of a vertical concentration gradient within the cap material. It will also provide a means to compare concentrations of TCDD and TCDF in pore water to those in overlying surface water.

Implementation of this method requires collection of data to evaluate the degree to which the PDMS is in equilibrium with the sediment matrix at the time of retrieval using PRCs, and conversion of the concentrations of congeners in the PDMS in each sample to an approximate concentration in porewater, using that information. Each of these steps is described below.

1.6.1.3.1 Measurement of Extraction Kinetics

The presence of a small amount of organic sorbent in a solution with hydrophobic organic compounds (such as dioxins) can greatly reduce the concentration of any given solute, even in a large volume of solution. In the sediment matrix, the surrounding sediment will replace this dissolved mass with desorption of the constituent from surrounding organic material. This process, however, is not instantaneous and may take some time to occur. Therefore, it is necessary to verify the degree to which the PDMS on the SPME fiber sample is in equilibrium with the sediment matrix, which includes porewater.

The approach to assess the equilibrium of the PDMS on the fibers with the sediment is to include fibers that have been impregnated with $^{13}C_{12}$-labeled TCDD and TCDF PRCs in four discrete sampling locations within the cap (Fernandez et al. 2009). The carbon atoms attached to these compounds are the heavier, non-radioactive ^{13}C isotope with an additional neutron in the nucleus of the atom. Because the number of protons controls most of the chemical behavior of the element, these ^{13}C-based compounds have the same chemical behavior as their respective corresponding unlabeled TCDD and TCDF congeners, but they can be chemically analyzed as distinct species. Fibers that have been impregnated with a known mass of $^{13}C_{12}$-labeled dioxins and furans are deployed at the same time as the sample fibers, within the same sampling device, in separate locations.

With the PRCs, one can determine the expected equilibrium concentration, even if the system has not reached chemical equilibrium (Fernandez et al. 2009) with the following equation:

$$C^{\infty}_{PDMS} = \frac{C_{PDMS(t)} C_{PRC,init}}{C_{PRC,init} - C_{PRC(t)}} \qquad \text{(Eq. 2)}$$

Where:

C^{∞}_{PDMS} = concentration of the target compound in the PDMS sorbent, at equilibrium

$C_{PDMS(t)}$ = concentration of the target compound in the PDMS measured at time t

$C_{PRC,init}$ = concentration of the PRC initially in the PDMS, and $C_{PRC(t)}$ is the concentration of the PRC in PDMS at time t

This simple equation works for situations where the target chemical(s) can be replicated with isotopically labeled PRC compound(s). To effectively perform this sampling, four samplers, each containing a PRC-impregnated fiber, will be deployed throughout the cap area (Figure 1-9). Because the selected PRCs have the same diffusion and absorption behavior as their corresponding congeners that could be present in the Site surface water or cap porewater, the PRC sampler must be some distance from the device to be used to collect the sample. This separation will prevent any PRCs that are released from the impregnated fiber from encountering the sample fiber and being absorbed into the sample.

1.6.1.3.2 Calculation of Estimated Porewater Concentrations

An approximation of the equilibrium porewater concentration can then be calculated from the equation:

$$C_{PW} = \left(\frac{C^{\infty}_{PDMS}}{K_{OW}}\right) \qquad \text{(Eq. 3)}$$

which is analogous to Equation 1, using the predicted final equilibrium condition for each congener expected in the system on the basis of the PRC results. Because the $K_{P\text{-}W}$ is not known and cannot be derived without a laboratory study specifically conducted for that purpose, the congener-specific K_{OW} is used as a surrogate. The resulting C_{PW} therefore cannot be interpreted to be an actual porewater concentration, but is an approximated one. Because all samples are corrected for the equilibrium condition at the time of the sampler retrieval, the resulting C_{PW} values are comparable within the sampling location, and between sampling locations.

1.6.2 DQOs for Study Element 4: Engineering Construction Evaluation

The RI Report will synthesize and summarize existing information on the Site to inform the evaluation of remedial alternatives in the FS. Additional information is needed on the performance of the TCRA cap in containing dioxins and furans, so that alternatives that consider the cap as a component of the final remedy can be effectively considered. Results from this study will be used to evaluate if dissolved TCDD and TCDF are being released from the area within the original 1966 impoundment perimeter, and if so, the specific location(s) where releases may be occurring.

1.6.2.1 Statement of the Problem

The TCRA cap was constructed according to design specifications and subsequently underwent QA/QC inspections by the construction contractor and by Anchor QEA. Following inspection, selected areas were reworked by the placement of additional rock in specific locations (Anchor QEA 2012). Anchor QEA (2012) presents an operations monitoring and maintenance (OMM) plan to ensure the physical integrity of the cap over time. A chemical monitoring plan is not included in the OMM plan. The engineering construction problem to be addressed by this study is the absence of qualitative, descriptive information on porewater quality within the cap, which can be used to support decisions about whether, and in what manner the OMM plan should address porewater and surface water quality. Qualitative analysis of the results of this study will also inform evaluation of design alternatives that could allow inclusion of the TCRA cap in the final remedy for the

area north of I-10, such as alternatives that include enhanced natural recovery or in-water treatment.

1.6.2.2 Analytical Approach

To address the performance of the cap in preventing the release of TCDD and TCDF into porewater and subsequently into surface water, a qualitative spatial description of the evaluation of vertical gradients described in Section 1.6.1 will be prepared. Each sampling location will be shown in a map of the study area (i.e., within the 1966 northern impoundment perimeter) in a manner that describes the nature and degree of any vertical concentration gradient of TCDD and TCDF observed. This qualitative evaluation will provide for a spatially refined description of cap performance.

1.6.2.3 Sample Collection Design

The sampling design is as described in Section 1.6.1, which will include collection of geospatial coordinates of the locations at which each sampler pair is deployed. A sample representative of surface water will be included at two locations to allow comparison of approximated TCDD and TCDF concentrations in porewater within the armored cap with that of surface water. Results will support a determination of whether the quality of cap porewater is essentially equivalent to that of overlying water. Such a finding would indicate that the cap is effective.

1.7 Special Training and Certification

A technical team will be assembled with the requisite experience and technical skills to successfully complete the 2012 TCRA cap porewater assessment study. All technical team personnel involved in sample collection will have extensive environmental sampling experience.

Sampling personnel who enter the exclusion zone and contaminant reduction zone (see Attachment A1, Sections 5.1.1 and 5.1.2 for definition and discussion of these zones) may be required to have completed the 40-hour Hazardous Waste Operations and Emergency Response standard training course and 8-hour refresher courses (see overall HASP [Anchor

QEA 2009] for further explanation). The training provides employees with knowledge and skills that enable them to perform their jobs safely and with minimum risk to their personal health. Documentation of course completion will be maintained in personnel files.

Selected laboratories will hold certification through the National Environmental Laboratory Accreditation Program for the methods which that laboratory will perform, where applicable. Training and certification requirements for laboratory personnel will be provided in the laboratory QA plans (to be submitted under separate cover).

1.8 Documents and Records

Records will be maintained documenting all activities and data related to sample collection and to laboratory analyses. Results of data verification and validation activities will also be documented. Procedures for documentation of these activities are described in this section.

The QAPP, FSP (Appendix A), and the HASP will be provided to every task participant listed in Section 1.1. Any revisions or amendments to any of the documents that make up the FSP will also be provided to these individuals.

1.8.1 Field Records

Components of field documentation are discussed in Section 3 of the FSP. Anchor QEA's field lead will ensure that the field team receives the final, approved version of the QAPP (including the FSP, HASP [Anchor QEA 2009], and HASP Addendum 5) prior to the initiation of field activities. Field records that will be maintained include the following:

- Field logbooks
- Photo documentation
- Field data and sample collection information forms (if any)
- Field change request forms (as needed)
- Sample tracking/chain-of-custody (COC) forms.

Observations recorded in the field logbook will be used to provide context and aid in presentation and interpretation of analytical results. Additional details regarding the content and use of these documents are described in Section 3.1 of the FSP.

1.8.2 Field Laboratory Records

All activities related to sample processing will be documented in either field logbooks or on field data forms at the field laboratory during sample preparation. At a minimum, the following information will be documented at the field laboratory:

- Sample preparation log
- Correlation between station number and sample number
- Depth interval of the PDMS fibers where the sample was collected and correlation of this depth interval to the sample number
- Correlation of all field replicates and field QC blanks to the respective station numbers and sample numbers
- Any deviations or observations that could impact sample quality
- Copies of all bottle certification forms
- Copies of all COCs and FedEx tracking forms.

1.8.3 Laboratory Data Reports

All activities and results related to sample analysis will be documented at the analytical laboratories. Internal laboratory documentation procedures are described in the laboratory QA manuals (to be submitted under separate cover).

The laboratory will provide a data package for each sample delivery group or analysis batch that is comparable in content to a full Contract Laboratory Program (CLP) package. The format of the data may differ from CLP requirements. Each data package will contain all information required for a complete QA review, including the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered
- A case narrative referencing or describing the procedures used and discussing any analytical problems and deviations from SOPs and this QAPP

- COCs and cooler receipt forms
- A summary of analyte concentrations (to two significant figures, unless otherwise justified), method reporting limits (MRLs), and method detection limits (MDLs) or estimated detection limits (EDLs)
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions
- Sample preparation, extraction, dilution, and cleanup logs
- Instrument tuning data
- Initial and continuing calibration data, including instrument printouts and quantification summaries, for all analytes
- Results for method and laboratory blanks
- Results for all QA/QC checks, including but not limited to labeled compounds, surrogate spikes, internal standards, and laboratory control samples provided on summary forms
- Instrument data quantification reports for all analyses and samples
- Copies of all laboratory worksheets and standards preparation logs.

Data will be delivered by the analytical laboratories in both hard copy and electronic format to the task QA coordinator, who will be responsible for oversight of data verification and validation and for archiving the final data and data quality reports in the project file. Electronic data deliverables (EDDs) will be compatible with the project database.

1.8.4 Data Quality Documentation

Data verification (i.e., confirming the accuracy and completeness of field and laboratory data) will be completed by the SJRWP technical team for data generated in the field, and by each laboratory for the data that it generates. Data validation reports for chemical analyses will be prepared as described in Section 4 and provided to the task QA coordinator. All changes to data stored in the database will be recorded in the database change log. Any data tables prepared from the database for data users will include all qualifiers that were applied by the laboratory and during data validation.

1.8.5 Reports and Deliverables

The laboratories will keep the laboratory QA coordinator apprised of their progress on a weekly basis. The laboratories will provide the following information:

- Inventory and status of samples held at the laboratory in spreadsheet format by sample delivery group
- Summaries of out-of-control laboratory QC data and any corrective actions implemented
- Descriptions and justification for any significant changes in methodology or QA/QC procedures.

2 DATA GENERATION AND ACQUISITION

This section provides a concise summary of the study design, and several subsequent sections on sampling and analytical methods, sample handling, equipment inspections and quality control measures.

2.1 Sampling Design

TCRA cap porewater assessment study will be performed using SPMEs placed at 14 different locations within the cap area. At two of these locations (SJCP001 and SJCP009), replicate samplers will be deployed. Each sampler results in enough sample fiber to generate three individual samples representing the porewater at different depths within the cap. Results will enable an evaluation of the absence or presence and direction of vertical gradients in TCDD and TCDF concentrations in the protective rock cover to assess whether the cap is performing adequately.

The sampling design also includes the use of additional samplers at four unique sampling locations separate from the 14 samplers, each equipped with a fiber impregnated with PRCs to be used to evaluate the equilibrium status of the samplers at the time of retrieval. These PRC-equipped samplers will be deployed at four locations (Figure 1-9).

Finally, at two sampling locations (SJCP005 and SJCP008), and at one PRC-equipped sampler SJCR002), an additional fiber will be attached to the sampler above the cap surface, and will be exposed to surface water. The attachment to the sampler above the sediment water interface will contain a discrete fiber (i.e., not connected to the porewater fiber) from which a sample will be collected to provide a representation of surface water. The PRC-impregnated surface water sample will be placed at least 30 feet away from the two samplers with extensions in surface water.

The planned sampling locations are shown in Figure 1-9. Table 2-1 summarizes the samples to be collected under this SAP in terms of location, placement, analytes, and study element.

2.2 SPME Sampling Methods

Sampling methods that will be used to collect the suite of samples summarized in Section 2.1 are presented in the following sections. Sampling methods are described in detail in the FSP (Appendix A). Detailed information on the preparation of samplers, their deployment, retrieval and processing is provided in Attachment A2 to Appendix A, in the SPME method description.

Stainless-steel SPME holders, which are divided in half with a stainless-steel plate and containing PDMS coated glass fibers (Figure 1-7), will be inserted into the cap layer at each of the sampling locations and allowed to equilibrate *in situ* for approximately 30 days with the porewater. The samples will then be retrieved and submitted for analysis.

The basic method to be employed in sample collection is that developed by Dr. Reible under the Department of Defense's Environmental Security Technology Certification Program, Environmental Restoration Project ER-0624, "Demonstration and Evaluation of Solid Phase Microextraction for the Assessment of Bioavailability and Contaminant Mobility." One SPME will be placed directly into the sediments at each sampling location with another SPME suspended above it to collect data on the concentration of PCDDs and PCDFs in the overlying water. Furthermore, at three of the stations a second SPME will be inserted beside the original SPME to provide field replicate information.

After an approximate 30-day exposure period, the SPMEs will be retrieved and transported to the dioxin analytical laboratory. The PDMS coated fibers from one side of the SPME will be sectioned, cut, and placed in hexane. The fibers and solvent will be analyzed for all seventeen 2,3,7,8-substituted PCDDs and PCDFs using EPA Method 1613B (USEPA 1994) via high resolution gas chromatography/mass spectrometry.

Identical PDMS coated fibers (which prior to placement were pre-equilibrated with PRCs) located on the second of the two SPME samplers in each pair will also be sectioned, cut, and placed in hexane. The fibers and solvent will be analyzed using EPA Method 1613B (USEPA 1994) via high performance liquid chromatography. The amount of the PRCs in the sample

will be used to develop a model of the extent of equilibrium of each target analyte measured in the PCDDs and PCDFs samples.

The installation of the SPME will involve use of a pilot probing rod that can be used to identify if there are significant obstructions that would prevent the installation of an SPME sampler and the thickness of a cap at each location. If significant obstructions are found during field deployment, the location may be moved laterally to find a more suitable area. The field crew will attempt to maintain all samplers within 30 feet of the preplanned locations. The exact location of each sampler will be determined using a differential global positioning system and recorded as the samplers are installed. Details on the SPME pre-deployment preparation, deployment, and retrieval and processing are described in the FSP (Appendix A) and Appendix B.

2.3 Sample Handling and Custody

Principal documents used to identify samples and to document sample possession will be field logbooks and COC records. Custody will be documented for all samples at all stages of the analytical or transfer process. COC procedures for sample handling prior to delivery to the analytical laboratory are outlined in Section 3.5 of the FSP.

Upon receipt of samples at each laboratory, the physical integrity of the containers and seals will be checked, and the samples will be inventoried by comparing sample labels to those on the COC forms. The laboratory will include the COC and shipping container receipt forms in the data package. Any breaks in the COC or non-conformances will be noted and reported in writing to the project laboratory coordinator within 24 hours of receipt of the samples. The laboratory QA plan (to be provided under separate cover) includes procedures used for accepting custody of samples and documenting samples at the laboratory. The laboratory project manager will ensure that a sample-tracking record is maintained that follows each sample through all stages of sample processing at the laboratory.

Samples will be stored in accordance with Table 2-2. Samples for chemical analyses will be stored under refrigeration (4 ± 2°C) at the field laboratory. Once samples are received at the testing laboratories they will be stored in a refrigerator at 4°C. Each laboratory will maintain

COC documentation and documentation of proper storage conditions for the entire time that the samples are in its possession.

The laboratories will not dispose of the samples for this task until authorized to do so by the task QA coordinator. After authorization is obtained, each laboratory will dispose of samples, as appropriate, based on matrix, analytical results, and information received from the client.

2.4 Laboratory and Analytical Methods

The extraction of the SPME samples begins in the field laboratory as described in Section 2.2.1. This section discusses the handling and analysis of the extracts after they are received at the laboratory.

SPME samples collected for this study will be analyzed for PCDDs, PCDFs, and PRCs using the proposed laboratory methods as described below and summarized in Table 2-3. These methods are consistent with requirements provided in SW-846 (USEPA 2008b) and other established and widely accepted protocols. The analyte list is provided in Table 2-4.

Samples for PCDD, PCDF, and PRC analysis will be analyzed by ALS Columbia in accordance with USEPA Method 1613B (USEPA 1994) using high resolution gas chromatography/mass spectroscopy. All samples will be concentrated to 20 µL of solvent before analysis to provide the lowest detection limits possible.

It is not expected that extract cleanup will be necessary and all samples will be initially analyzed without cleanups. If interferences are encountered, silica gel cleanup or additional cleanup procedures will be used as necessary. Samples will be analyzed by high-resolution gas chromatography with high-resolution mass spectrometry. Detection limits are calculated on an individual compound and sample basis and depend on the signal-to-background ratio for the specific labeled isomer.

2.5 Quality Control

QC samples will be prepared in the field and at each laboratory to monitor the bias and precision of the sample collection and analysis procedures.

2.5.1 Field Quality Control

Field QC samples for this study will include field replicate samples (co-located SPMEs), solvent rinse blank, solvent blank, caulk blank, distilled water blank, and environmental blanks.

Field replicate samples will be collected at a frequency of one for every 10 field samples processed. The solvent rinse blank will consist of solvent collected at Dr. Reible's laboratory after the SPME sampling devices have been decontaminated. The solvent blank will be a sample of the hexane used at the field laboratory to extract the PCDDs and PCDFs from the glass fibers. The distilled water blank will also be collected at the field laboratory and will be a sample of the laboratory-grade distilled water use to rinse the glass fibers prior to sectioning. The caulk blank will be collected from the caulk used to hold the SPME fibers to the sampling device. Two environmental blanks (one exposed during SPME deployment and one exposed during SPME retrieval) will be collected to determine if any airborne contamination could possibly have affected the samples.

Procedures for preparing the field quality control samples are presented in Section 2.3 of the FSP. Validation criteria and procedures for field QC samples are described in Sections 4.1 and 4.2 of this SAP.

2.5.2 Laboratory Quality Control

Extensive and detailed requirements for laboratory QC procedures are provided in the methods that will be used for this investigation (Table 2-3). QC requirements include control limits and requirements for corrective action in many cases. QC procedures will be completed by each laboratory, as required by each protocol and as indicated in this QAPP. Laboratory QC procedures are addressed below.

The overall quality objective for this task is to develop and implement procedures that will ensure the collection of representative data of known and acceptable quality. The QA procedures and measurements that will be used for this project are based on USEPA guidance (USEPA 2002b, 2008b).

2.5.2.1 *Laboratory QA*

Laboratory QC for the dioxin and furan analysis will consist of a field laboratory blank, an analytical laboratory blank, a laboratory control sample, a laboratory control sample duplicate, and the use of labeled compounds and internal standards. The frequency of analysis for laboratory control samples, laboratory control samples, and method blanks will be one for every 20 samples or one per extraction batch, whichever is more frequent. Labeled compounds and internal standards will be added to every field sample and QC sample. Calibration procedures will be completed at the frequency specified in the method description. Performance-based control limits have been established by each laboratory. These and all other control limits specified in the method descriptions will be used by the laboratories to establish the acceptability of the data or the need for reanalysis of the samples. Laboratory control limits for recoveries of labeled compounds, laboratory control samples, and for relative percent difference (RPD) of laboratory control samples duplicates are provided in each laboratory's QA manual (to be submitted under separate cover).

PARCC parameters (i.e., precision, accuracy or bias, representativeness, completeness, comparability) are commonly used to assess the quality of environmental data. Bias represents the degree to which a measured concentration conforms to the reference value. The results for laboratory control samples, field blanks, and method blanks will be reviewed to evaluate bias of the data.

The following calculation is used to determine percent recovery for a laboratory control sample:

$$\%R = (M / C) \times 100 \qquad \text{(Eq. 4)}$$

Where:

%R	=	percent recovery
M	=	measured concentration in the spiked sample
U	=	measured concentration in the unspiked sample
C	=	concentration of the added spike

Results for field and laboratory blanks can reflect systematic bias that results from contamination of samples during collection or analysis. Any analytes detected in field or laboratory blanks will be evaluated as potential indicators of bias.

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of laboratory control sample duplicates and field replicates. Precision is expressed in terms of the RPD for two measurements. The following equation is used to calculate the RPD between measurements:

$$RPD = |[(C1 - C2) / ((C1 + C2) / 2)]| \times 100 \quad \text{(Eq. 5)}$$

Where:

RPD	=	relative percent difference
C1	=	first measurement
C2	=	second measurement

Completeness will be calculated as the ratio of usable data (i.e., unqualified data and *U*- or *J*-qualified data) to generated data, expressed as a percentage. Completeness will be calculated for each suite of analytes for each sample type and sampling event.

Additional laboratory QC results will be evaluated to provide supplementary information regarding overall quality of the data, performance of instruments and measurement systems, and sample-specific matrix effects.

QC samples and procedures are specified in each method protocol that will be used for this project. Methods are summarized in Table 2-3. All QC requirements will be completed by each laboratory as described in the protocols, including the following (as applicable to each analysis):

- Instrument tuning
- Initial calibration
- Initial calibration verification
- Continuing calibration verification
- Calibration or instrument blanks
- Method blanks
- Laboratory control samples
- Internal standards
- Surrogate spikes/labeled compounds.

To alert the data user to possible bias or imprecision, data qualifiers will be applied to reported analyte concentrations when associated QC samples or procedures do not meet control limits. Laboratory control limits for the methods that will be used for this Site investigation are provided in Table 2-3 and in the laboratory QA manuals (to be provided under separate cover). Data validation criteria and procedures are described in Section 4.

PCDDs and PCDFs concentrations for this task, in picograms per fiber, will be reported to the sample specific EDLs as described in USEPA Method 8290A (USEPA 2007). Analytes detected at concentrations between the MRL and the EDL will be reported with a J qualifier to indicate that the value is an estimate (i.e., the analyte concentration is below the calibration range). Nondetects will be reported at the EDL for PCDD and PCDF congeners. The MRLs and EDLs will be adjusted by each laboratory, as necessary, to reflect sample dilution and/or matrix interference.

Target MRLs and EDLs for this study are summarized in Table 2-4 where possible. MRLs are established by the laboratories at levels above the MDLs for the project analytes. The MRL values are based on the laboratories' experience analyzing environmental samples and reflect the typical sensitivity obtained by the analytical system in environmental samples. For this

task, the concentration of the lowest standard in the initial calibration curve for each analysis is at the level of the MRL. This allows reliable quantification of concentrations to the MRL in the absence of matrix interferences.

2.5.2.2 *Representativeness and Comparability of All Data*

Representativeness and comparability are qualitative QA/QC parameters. Representativeness is the degree to which data represent a characteristic of an environmental condition. In the field, representativeness will be addressed primarily in the sampling design by the selection of sampling sites and sample collection procedures. In the laboratories, representativeness will be ensured by the proper handling and storage of samples and initiation of analysis within holding times.

Comparability is the qualitative similarity of one dataset to another (i.e., the extent to which different datasets can be combined for use). Comparability will be addressed through the use of laboratory methods that are consistent with methods and procedures recommended by USEPA and are commonly used for environmental studies.

2.6 Instrument and Equipment Testing, Inspection, and Maintenance

Analytical instrument testing, inspection, maintenance, setup, and calibration will be conducted by each laboratory in accordance with the requirements identified in the laboratory's SOPs and manufacturer instructions. In addition, each of the specified analytical methods provides protocols for proper instrument setup and tuning, and critical operating parameters. Instrument maintenance and repair will be documented in the maintenance log or record book.

2.7 Inspection and Acceptance of Supplies and Consumables

The quality of supplies and consumables used during sample collection and laboratory analysis can affect the quality of the project data. All equipment that comes into contact with the samples and extracts must be sufficiently clean to prevent detectable contamination, and the analyte concentrations must be accurate in all standards used for calibration and QC purposes.

During sample collection, the quality of laboratory water used for decontamination will be documented at the laboratory that provides that water. Precleaned sample vials (with documentation) will be provided by the laboratories. All containers will be visually inspected prior to use, and any suspect containers will be discarded.

Reagents of appropriate purity and suitably cleaned laboratory equipment will also be used for all stages of laboratory analyses. Details for acceptance requirements for supplies and consumables at the laboratories are provided in the laboratory SOPs and QA manuals (to be provided under separate cover). All supplies will be obtained from reputable suppliers with appropriate documentation or certification. Supplies will be inspected to confirm that they meet use requirements, and certification records will be retained by Integral (i.e., for supplies used in the field) or the laboratories.

2.8 Non-direct Measurements

Existing chemical data from previous investigations will be used to guide this study. As discussed in the RI/FS Work Plan, historical data will be reviewed for QA and acceptability for use in the RI/FS. No nondirect measurements will be required for this study.

2.9 Data Management

During field, laboratory, and data evaluation operations, effective data management is critical to providing consistent, accurate, and defensible data and data products. Data management systems and procedures will be used to establish and maintain an efficient organization of the environmental information collected. Procedures and standards for conducting specific data management tasks (i.e., creation, acquisition, handling, storage, and distribution of data) will be documented in a project data management manual. Essential elements of data management and reporting activities associated with the TCRA cap porewater assessment program are discussed in the following sections.

Project data will be maintained in a relational database designed to accommodate all the types of environmental measurements that will be made during this RI/FS, as described in

the Data Management Plan, which is included as Appendix B of the RI/FS Work Plan. Online access to the database will be provided to members of the project team and regulatory oversight bodies through a browser-based interface that provides information on the status and contents of the project database, and that allows users to create custom data tables and maps.

2.9.1 Field Data

Daily field records (a combination of field logbooks, field forms, global positioning system records, and COC forms) will make up the main documentation for field activities. Detailed guidelines for entry of information during field sampling are provided in the FSP, which is included as Appendix A to this SAP. Upon completion of sampling, hard-copy notes and forms will be scanned to create an electronic record for use in creating the draft porewater assessment study report. Information on sampling locations, dates, SPME penetration depth into the cap, sampling interval within the SPME, and other conditions, and sample identifiers, will be entered into the project database. One hundred percent of hand-entered data will be verified based on hard copy records. Electronic QA checks to identify anomalous values will also be conducted following entry.

2.9.2 Laboratory Data

The analytical laboratories will each submit data in both electronic and hard-copy format. The project database administrator or his designated data manager will provide the desired format for EDDs to the laboratories, and the project data manager and laboratory coordinator will discuss these specifications with laboratory QA managers prior to data delivery and tailor them as necessary to specific laboratory capabilities. QA checks of format and consistency will be applied to EDDs received from the laboratory. After any issues have been resolved, the data will be loaded into the project database. Each dataset loaded will be linked to the electronic document of the relevant laboratory data package. Data summaries will be produced from the database for use by data validators. Validators will return edited versions of these summaries, and the edits will then be incorporated into the database. An automated change log will be maintained by the database so that the history of all such edits is maintained, and the provenance of each data value can be determined.

3 ASSESSMENT AND OVERSIGHT

This task will rely on the knowledge and expertise of the SJRWP technical team, as described in the RI/FS Work Plan, and Dr. Danny Reible of UT (Appendix B). The field team and laboratories will stay in close verbal contact with the task manager and task QA coordinator during all phases of this task. This level of communication will serve to keep the management team informed about activities and events, and will allow for informal but continuous task oversight.

3.1 Assessment and Response Actions

Assessment activities will include readiness reviews by the field coordinator prior to sampler deployment, by the database administrator prior to release of the final data to the data users, and internal review while work is in progress. An informal technical systems audit may be conducted if problems are encountered during any phase of this project.

The first readiness review will be conducted by the field lead prior to field sampling to verify that all field equipment is ready for transfer to the Site. The field lead will also verify that the field team and any subcontractors have been scheduled and briefed and that the contracts for the subcontractors have been signed by both parties. Any deficiencies noted during this readiness review will be corrected prior to initiation of sampling activities.

The second readiness review will be completed by the database administrator before final data are released for use to verify that all results have been received from each laboratory, data validation and data quality assessment have been completed for all of the data, and data qualifiers have been entered into the database and verified. Any deficiencies noted during this review will be corrected by the database administrator, the task QA coordinator, or their designee. Data will not be released for final use until all data have been verified and validated. No report will be prepared in conjunction with the readiness reviews. However, the SJRWP technical team coordinator and data users will be notified when the data are ready for use.

Technical review of intermediate and final work products generated for this task will be completed throughout the course of all sampling, laboratory, data validation, data

management, and data interpretation activities to ensure that every phase of work is accurate and complete and follows the QA procedures outlined in this QAPP. Any problems that are encountered will be resolved between the reviewer and the person completing the work. Any problems that cannot be easily resolved or that affect the final quality of the work product will be brought to the attention of the SJRWP technical team coordinator and SJRWP project coordinator.

Each laboratory will be required to have implemented a review system that serves as a formal surveillance mechanism for all laboratory activities. Details are provided in the laboratory QA plans (Appendix B).

Technical system audits may be conducted if serious problems are encountered during sampler preparation, sampler deployment and retrieval or analysis operations. If completed, these audits will be conducted by the task QA coordinator or designee, or by the laboratory, as appropriate. These audits may consist of on-site reviews of any phase of field or laboratory activities or data management. Results of any audits will be provided in the RI/FS Report.

Any task team member who discovers or suspects a nonconformance is responsible for reporting the nonconformance to the task manager, the task QA coordinator, or the laboratory project or QA manager, as applicable. The task QA coordinator will ensure that no additional work dependent on the nonconforming activity is performed until a confirmed nonconformance is corrected. Any confirmed nonconformance issues will be relayed to the SJRWP technical team coordinator.

3.2 Reports to Management

The laboratories will keep the laboratory coordinator informed of their progress on a weekly basis. The laboratories will provide the following information:

- Deviations from the SPME method description during preparation of samplers
- Inventory and status of samples held at the laboratory in spreadsheet format by sample delivery group
- Summaries of any laboratory QC data outside of control limits and any corrective actions implemented

- Descriptions and justification for any significant changes in methodology or QA/QC procedures.

The task laboratory coordinator will provide this information to the task QA coordinator, who will provide this information to the task manager.

Each laboratory will be required to have implemented routine systems of reporting nonconformance issues and their resolution. These procedures are described in the laboratory QA manuals (to be submitted under separate cover). Laboratory nonconformance issues will also be described in the RI/FS report if they affect the quality of the data.

Data packages and EDDs will be prepared by each laboratory upon completion of analyses for each sample delivery group. The case narrative will include a description of any problems encountered, control limit exceedances (if applicable), and a description and rationale for any deviations from protocol. Copies of corrective action reports generated at the laboratory will also be included with the data package.

Data validation reports will be prepared following receipt of the complete laboratory data packages for each sample delivery group. These reports will be provided to the task QA coordinator when validation is completed for each parameter. A summary of any significant data quality issues will be provided to USEPA with the RI/FS report.

4 DATA VALIDATION AND USABILITY

Data generated in the field and at the laboratories will be verified and validated according to criteria and procedures described in this section. Data quality and usability will be evaluated, and a discussion will be included in the RI/FS Report.

4.1 Criteria for Data Review, Verification, and Validation

Field and laboratory data for this task will undergo a formal verification and validation process. All entries into the database will be verified. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

Data verification and validation for PCDDs, PCDFs, and PRCs will be completed in accordance with Guidance on Environmental Data Verification and Validation (USEPA 2002a) and according to methods described in USEPA's national functional guidelines for organic methods data and chlorinated dioxin/furan data review (USEPA 2008a, 2011). Performance-based control limits established by the laboratories and control limits provided in the method protocols will be used to evaluate data quality and determine the need for data qualification. Performance-based control limits are established periodically by each laboratory. Current values will be provided in the laboratory QA plans (to be submitted under cover), as applicable.

Results for field replicates will be evaluated against a control limit of 50 percent RPD. Data will not be qualified as estimated if this control limit is exceeded, but RPD results will be tabulated, and any exceedances will be discussed in the RI/FS Report. Field blanks will be evaluated and data qualifiers will be applied in the same manner as method blanks, as described in the functional guidelines for data review (USEPA 2008a, 2011).

Data will be rejected if control limits for acceptance of data are not met, as described in the functional guidelines for data review (USEPA 2008a, 2011).

4.2 Verification and Validation Methods

4.2.1 Sampler Preparation Records

Laboratory logbooks maintained during the preparation of samplers (SPME method description, in Attachment A2 to Appendix A) will be verified during preparation of samplers and COC forms. Laboratory logbooks and COC forms will be reviewed daily by the SPME laboratory manager, or his designee. After laboratory logbook data are entered into the project database, 100 percent verification of the entries will be completed by a second party to ensure the accuracy and completeness of the database. Any discrepancies will be resolved before the final database is released for use.

4.2.2 Field Data

Field data will be verified during preparation of samples and COC forms. Field data and COC forms will be reviewed daily by the field lead. After field data are entered into the project database, 100 percent verification of the entries will be completed by a second party to ensure the accuracy and completeness of the database. Any discrepancies will be resolved before the final database is released for use.

4.2.3 Chemistry Data

Chemistry data verification and validation will be completed as described in Section 4.1 by either Integral or a data validation firm. Data packages for QC samples (e.g., SPME blank, caulk blank, solvent rinses, etc.) will be validated based on a review of the sample and QC data, equivalent to a Stage 2A validation as described in USEPA (USEPA 2009b). The first data package of field samples for each analysis method will be fully validated, equivalent to a Stage 4 validation. If no major problems are encountered during validation of this package validation for the remaining data will be based on a review of the sample and instrument QC data, equivalent to a Stage 2B validation. If problems are encountered, the laboratory will be contacted for resolution. Additional full validation will be completed if required to fully assess the quality of the data to verify that the laboratory errors have been addressed.

The accuracy and completion of the database will be verified at each laboratory when the EDDs are prepared and again as part of data validation. Ten percent of entries to the

database from laboratory EDDs will be checked against hard-copy data packages. In addition to verification of field and laboratory data and information, data qualifier entries into the database will be verified. Any discrepancies will be resolved before the final database is released for use.

Detection limits for nondetects will be compared to the EDL and MDL goals listed in Table 2-4 to evaluate method sensitivity for each sample. Any exceedance of actual EDLs or MDLs over the target MDLs will be discussed in the RI/FS Report.

4.3 Reconciliation with User Requirements

The goal of data validation is to determine the quality of each data result and to identify those that do not meet the task measurement quality objectives. Nonconforming data may be qualified as estimated (i.e., a J qualifier will be applied to the result) or rejected as unusable (i.e., an R qualifier will be applied to the result) during data validation if criteria for data quality are not met. Rejected data will not be used for any purpose. An explanation of the rejected data will be included in the RI/FS Report.

Data qualified as estimated will be used for all intended purposes and will be appropriately qualified in the final project database. However, these data are less precise or less accurate than unqualified data. Data users, in cooperation with the SJRWP technical team coordinator and the task QA coordinator, are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on statistical procedures and other data uses.

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TABLES

Table 1-1
TCRA Armor Cap Rock Components

Material	Stone Size D_{50} (inches)	Minimum Thickness (inches)	Installed Quantity (tons)
Armor Cap A	3	12	13,500
Armor Cap B/C	6	12	11,300
Armor Cap C	6	12	10,100
Armor Cap D, D_{24}	8	18, 24	23,900
		Total:	58,800

Notes
All quantities have been rounded to the nearest 100 tons.

Table 1-2
Concentrations of Chemicals of Potential Concern in Groundwater Samples

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	TRRP GW_{Class3} PCL							
PhysChem (mg/L)								
TSS		2.5 U	6.5	2.5 U	2.5 U	42	23	14
Metals (mg/L)								
Aluminum	7,300	0.056	0.12	0.17	0.043 J	0.205	0.12	0.48
Arsenic	1	0.0092	0.005	0.0016	0.0086	0.0073	0.0063	0.0075
Barium	200	0.15	0.52	0.45	0.19	0.21	3.8	0.47
Cadmium	0.5	0.0016 J	0.001 U	0.001 U	0.001 U	0.00265 J	0.001 U	0.0029 J
Chromium	10	0.001 U	0.001 U	0.001 U	0.001 U	0.0016 J	0.005 J	0.022
Cobalt	2.2	0.0017	0.002	0.00026	0.00038	0.00165	0.0031	0.0033
Copper	130	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0037 J
Lead	1.5	1.7E-05 J	8.40E-05	0.00011	2.4E-05 J	0.000245	0.00015	0.0032
Magnesium	--	490	210	38	350	330	330	370
Manganese	1,000	1.9	1.4	0.12	1.7	2	4.4	2
Mercury	0.2	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	0.00017 J
Nickel	150	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.078
Thallium	0.2	5E-06 U	5.30E-05	1.9E-05 J	5E-06 U	0.00022	8E-06 U	5E-06 U
Vanadium	0.51	3E-05 U	0.0005	0.0015	6E-05 U	0.000595	0.0024	0.0011
Zinc	2,200	0.0004 UJ	0.0054 J	0.0004 UJ	0.0004 UJ	0.0041 U	0.0004 UJ	0.14
Dissolved Metals (mg/L)								
Aluminum	--	0.05 J	0.048 J	0.015 U	0.037 J	0.058	0.031 J	0.052
Arsenic	--	0.0095	0.0049	0.0019	0.0085	0.00695	0.0072	0.0073
Barium	--	0.15	0.56	0.45	0.19	0.215	3.8	0.45
Cadmium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.0026 J	0.002 J	0.0022 J
Chromium	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0028 J	0.001 U
Cobalt	--	0.0017	0.0019	0.00025	0.00035	0.00155	0.0031	0.0007
Copper	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lead	--	5.5E-06 U	2.4E-05 J	5E-06 U	5E-06 U	2.1E-05 J	3E-05 J	1.9E-05 J
Magnesium	--	490	210	37	350	330	330	370
Manganese	--	2	1.5	0.11	1.7	2	4.4	2
Mercury	--	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 UJ	1E-05 U
Nickel	--	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.0093 J
Thallium	--	5E-06 U	9.5E-06 U	8.5E-06 U	5.5E-06 U	1.1E-05 U	5.5E-06 U	5E-06 UJ
Vanadium	--	3E-05 U	0.0002 J	0.0014	3E-05 U	3E-05 U	0.0022	0.00023 J
Zinc	--	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ	0.0004 UJ

Table 1-2
Concentrations of Chemicals of Potential Concern in Groundwater Samples

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	TRRP GW_{Class3} PCL							
Semivolatile Organic Compounds (µg/L)								
Acenaphthene	440,000	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U
Fluorene	290,000	0.014 U	0.014 U	0.014 U	0.014 U	0.014 U	0.014 U	**0.03 J**
Naphthalene	150,000	**0.031 J**	0.011 U	0.011 U	**0.025 J**	**0.0295 J**	**0.033 J**	**0.046 J**
Phenanthrene	220,000	0.011 U	**0.029 J**	0.011 U	0.011 U	0.011 U	0.011 U	**0.099 J**
Bis(2-ethylhexyl)phthalat	600	0.065 U	0.065 U	0.065 U	0.065 U	**0.0975 J**	0.065 U	**0.49 J**
Phenol	2,200,000	0.032 U	**0.07 J**	**0.14 J**	0.032 U	**0.0795 J**	0.032 U	**1.1**
Carbazole	10,000	0.009 U	0.009 U	0.009 U	0.009 U	**0.018 J**	0.009 U	**0.054 J**
PCBs (pg/L)								
Aroclor 1016	--	480 U	480 U	2,400 U	480 U	480 U	480 U	40,000 U
Aroclor 1221	--	480 U	480 U	20,000 U	480 U	480 U	480 U	95,000 U
Aroclor 1232	--	480 U	480 U	4,800 U	480 U	480 U	480 U	85,000 U
Aroclor 1242	--	480 U	480 U	2,900 U	480 U	480 U	480 U	75,000 U
Aroclor 1248	--	480 U	480 U	2,700 U	480 U	480 U	480 U	28,000 U
Aroclor 1254	--	480 U	480 U	480 U	480 U	480 U	480 U	31,000 U
Aroclor 1260	--	480 U	480 U	480 U	480 U	480 U	480 U	19,000 U
Aroclor 1262	--	480 U	480 U	480 U	480 U	480 U	480 U	480 U
Aroclor 1268	--	480 U	480 U	480 U	480 U	480 U	480 U	480 U
Total PCBs (Aroclor sum)	50,000,000	2,200 U	2,200 U	17,000 U	2,200 U	2,200 U	2,200 U	190,000 U
Dioxin/Furans (pg/L)								
2,3,7,8-TCDD	3,000	0.44 U	0.58 U	0.51 U	0.52 U	0.44 U	0.37 U	**2,700**
1,2,3,7,8-PeCDD	--	0.42 U	0.42 U	0.47 U	0.41 U	0.41 U	0.39 U	**25 J**
1,2,3,4,7,8-HxCDD	--	0.34 U	0.36 U	0.32 U	0.32 U	0.31 U	0.28 U	0.31 U
1,2,3,6,7,8-HxCDD	--	0.47 U	0.52 U	0.45 U	0.43 U	0.46 U	0.4 U	0.48 U
1,2,3,7,8,9-HxCDD	--	0.38 U	0.41 U	0.36 U	0.35 U	0.36 U	0.32 U	0.37 U
1,2,3,4,6,7,8-HpCDD	--	0.37 U	0.49 U	0.4 U	0.44 U	0.41 U	0.35 U	**25 J**
OCDD	--	1.1 U	0.79 U	0.62 U	0.55 U	**3.6 J**	7.2 U	**390**
2,3,7,8-TCDF	--	0.5 U	0.52 U	0.45 U	0.54 U	**1.89 J**	0.43 U	**9,100**
1,2,3,7,8-PeCDF	--	0.34 U	0.54 U	0.36 U	0.41 U	0.32 U	0.37 U	**270**
2,3,4,7,8-PeCDF	--	0.31 U	0.5 U	0.34 U	0.39 U	0.31 U	0.34 U	**170**
1,2,3,4,7,8-HxCDF	--	0.22 U	0.32 U	0.23 U	0.25 U	0.26 U	0.3 U	**520**
1,2,3,6,7,8-HxCDF	--	0.22 U	0.31 U	0.23 U	0.25 U	0.26 U	0.3 U	**110**
1,2,3,7,8,9-HxCDF	--	0.3 U	0.43 U	0.31 U	0.34 U	0.34 U	0.4 U	2.5 U
2,3,4,6,7,8-HxCDF	--	0.23 U	0.33 U	0.25 U	0.26 U	0.27 U	0.31 U	**14 J**
1,2,3,4,6,7,8-HpCDF	--	0.27 U	0.41 U	0.32 U	0.35 U	0.34 U	0.32 U	**120**

Table 1-2
Concentrations of Chemicals of Potential Concern in Groundwater Samples

	GWBU	C	C	C	A	A	A	B
	study_loc_id	SJMWD01	SJMWD02	SJMWD03	SJMWS01	SJMWS02	SJMWS03	SJMWS04
	sample_date	1/8/2011	1/5/2011	1/7/2011	1/8/2011	1/5/2011	1/7/2011	12/28/2011
	x	3216668.348	3217045.488	3217179.409	3216654.641	3217048.206	3217163.239	3216943.21
	y	13857340.83	13857702.27	13857082.67	13857356.47	13857716.27	13857082.92	13857673.38
	TRRP GW_{Class3} PCL							
1,2,3,4,7,8,9-HpCDF	--	0.48 U	0.66 U	0.54 U	0.58 U	0.51 U	0.51 U	**50**
OCDF	--	0.55 U	0.69 U	0.67 U	0.68 U	0.57 U	0.7 U	**81 J**
TEQ_{DF}		1.24 U	1.5 U	1.37 U	1.35 U	2.64 J	1.17 U	3770

Notes

Detected concentration is greater than GW_{Class3} screening level.
Bold = Detected result
-- = No Standard
J = Estimated value
U = Compound analyzed, but not detected above detection limit
UJ = Compound analyzed, but not detected above estimated detection limit

Samples SJMWS02-D1 & SJMWS02-D1 are averaged
If values are both ND, the lower detection limit is used
If one value is ND, that detection limit is used.

Table 1-3

Summary of Literature and Data-Based Partition Coefficients for Selected Dioxin and Furan Congeners

Compound	log K_{ow} Literature Range[a]	Mean log K_{oc} Value (from water column data)[b]	log K_{doc}[c]	
			Surface Water	Sediment Porewater
TCDD	5.4 – 8.9	6.9	4.9	5.9
TCDF	5.8 – 7.7	6.6	4.6	5.6
OCDD	7.3 – 13.1	9.1	7.1	8.1

Notes

TCDD = tetrachlorodibenzo-*p*-dioxin

TCDF = tetrachlorodibenzofuran

OCDD = octachlordibenzo-*p*-dioxin

a - As presented in Mackay et al. (1992)

b - Based on log-transformed regression after correction for dissolved organic carbon sorption

c - Based on log K_{ow} values from Govers and Krop (1998)

Table 2-1

Sampling Locations, Methods, and Analytes[a]

Sample Group	Sampling Method and Depth	Number of Locations	Sample Locations	Analytes	Study Elements
On-site TCRA cap monitoring stations	Sampling depth will vary based on the thickness of the cap at any given station; multiple samples will be collected at each station	14	Within the TCRA cap	TCDD, TCDF	Fate and transport and conceptual site model, engineering construction evaluation
		4		$^{13}C_{12}$-labeled TCDD and TCDF will be analyzed as performance reference compounds	

Notes

PCDD = polychlorinated dibenzo-*p*-dioxin
PCDF = polychlorinated dibenzofuran
SPME = solid-phase microextraction
TCRA = time critical removal action

a - Numbers do not include field quality control samples.

Table 2-2

Sample Containers,[a] Preservation, and Holding Time Requirements

Parameter	Laboratory	Container		Preservation	Holding Time
		Type	Size		
Dioxins/furans	ALS-Columbia - Houston	AG Vial	2 mL	4±2°C	6 months [b] 1 year [c]
$^{13}C_{12}$ -labeled dioxins and furans	ALS-Columbia - Houston	AG Vial	2 mL	4±2°C	6 months [b] 1 year [c]

Notes

AG = amber glass

a - Solid-phase microextraction samplers will be stored in containers consisting of a PVC (or similar) pipe with cap on both ends. These will be decontaminated prior to use following sampler assembly and prior to sampler retrieval.

b - Holding time prior to extraction

c - Holding time for extracts

Table 2-3
Laboratory Methods for Porewater Samples

Parameter	Laboratory	Sample Preparation		Quantitative Analysis	
		Protocol	Procedure	Protocol	Procedure
Dioxins/furans	ALS-Columbia - Houston	ER-0624	Solvent extraction	EPA 1613B	HRGC/HRMS
		EPA 1613B	Solvent concentration		
		EPA 1613B	Extract cleanup as needed		
$^{13}C_{12}$ -labeled dioxins and furans	ALS-Columbia - Houston	ER-0624	Solvent extraction	EPA 1613B	HRGC/HRMS

Notes
HRGC = high-resolution gas chromatography
HRMS = high-resolution mass spectrometry

FIGURES

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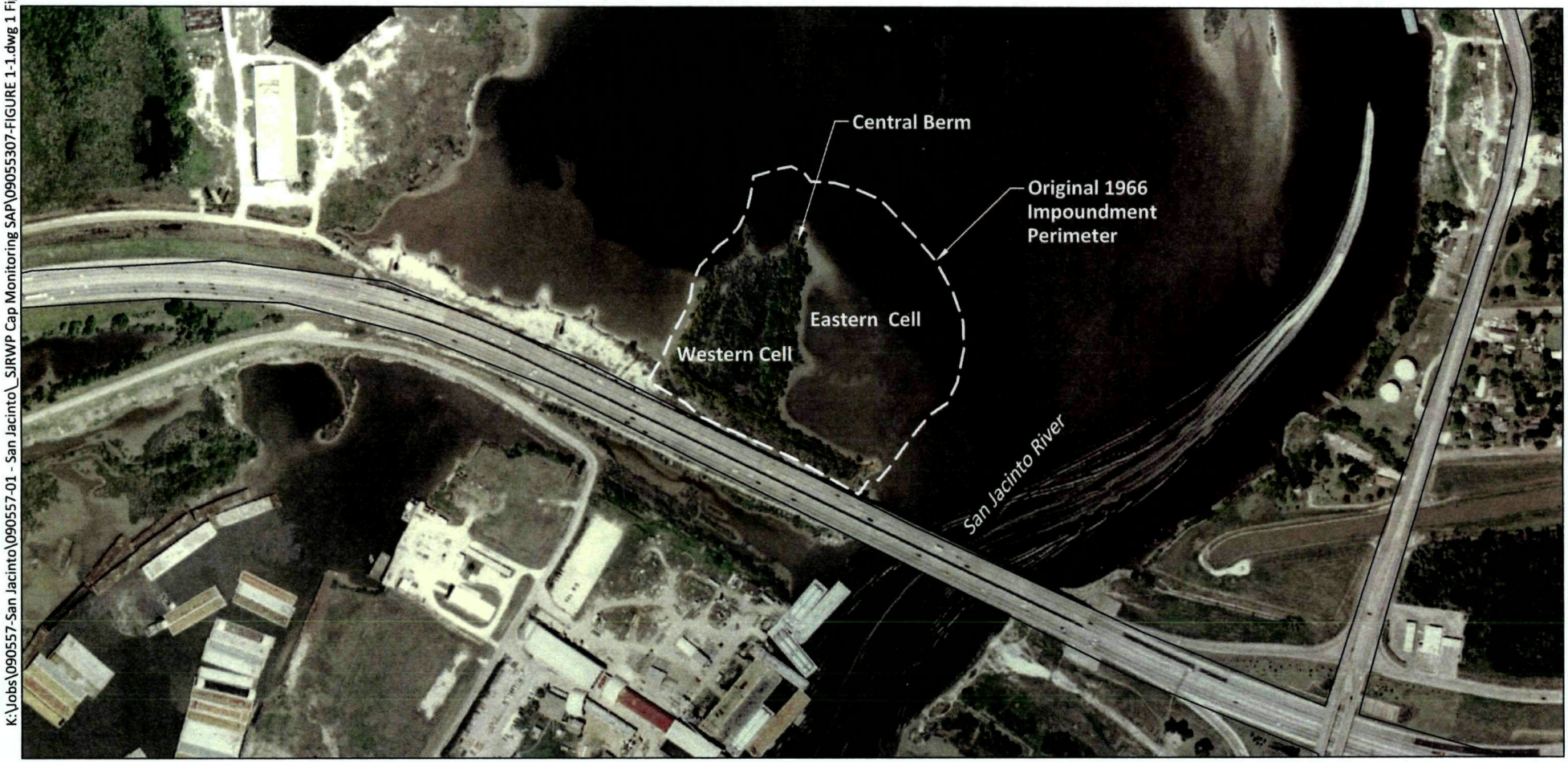

Apr 13, 2012 10:43am tgriga

SOURCE: Google Map Pro 2009

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Scale in Feet

ANCHOR QEA integral consulting inc

Figure 1-1
TCRA Vicinity Map
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC

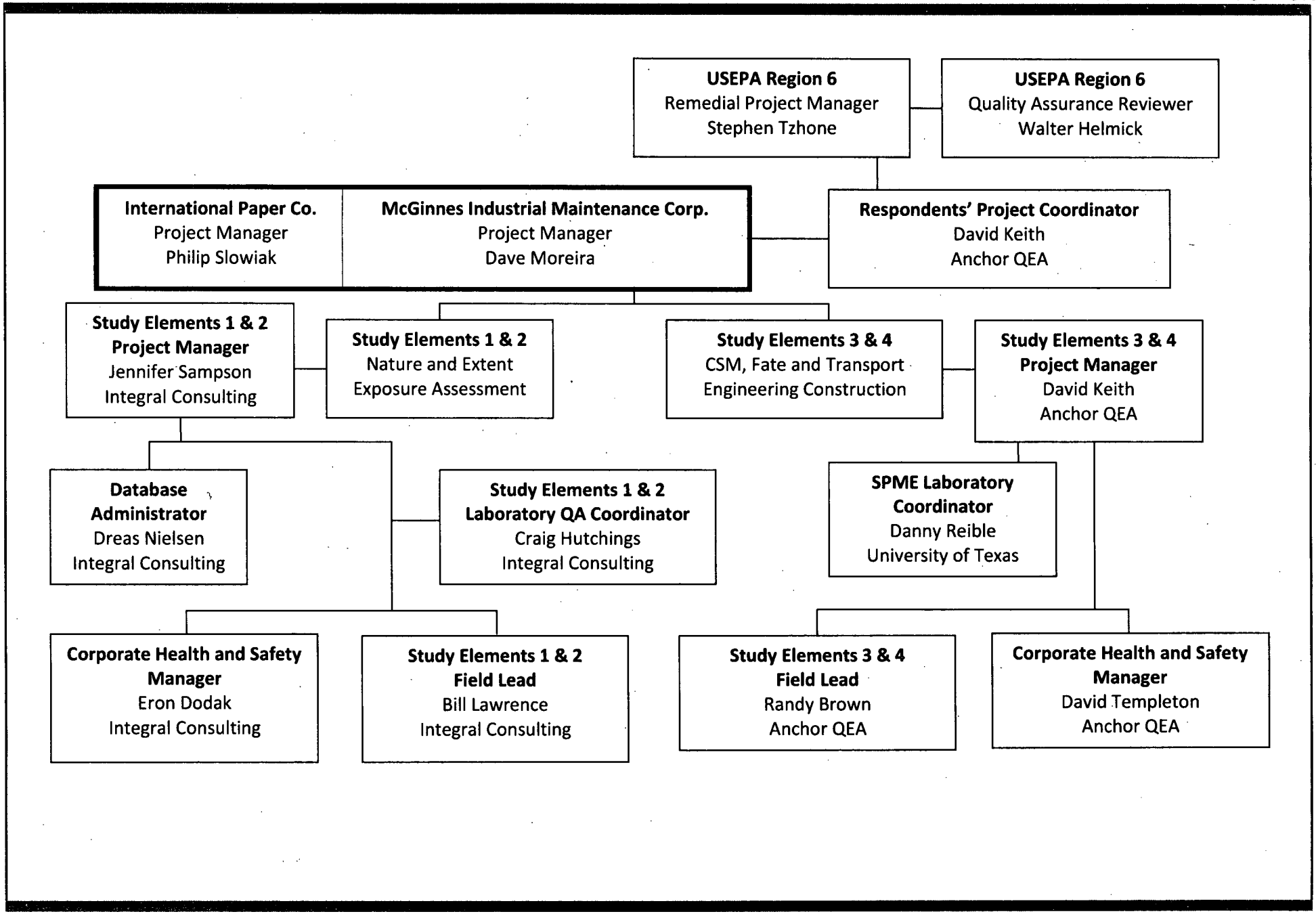
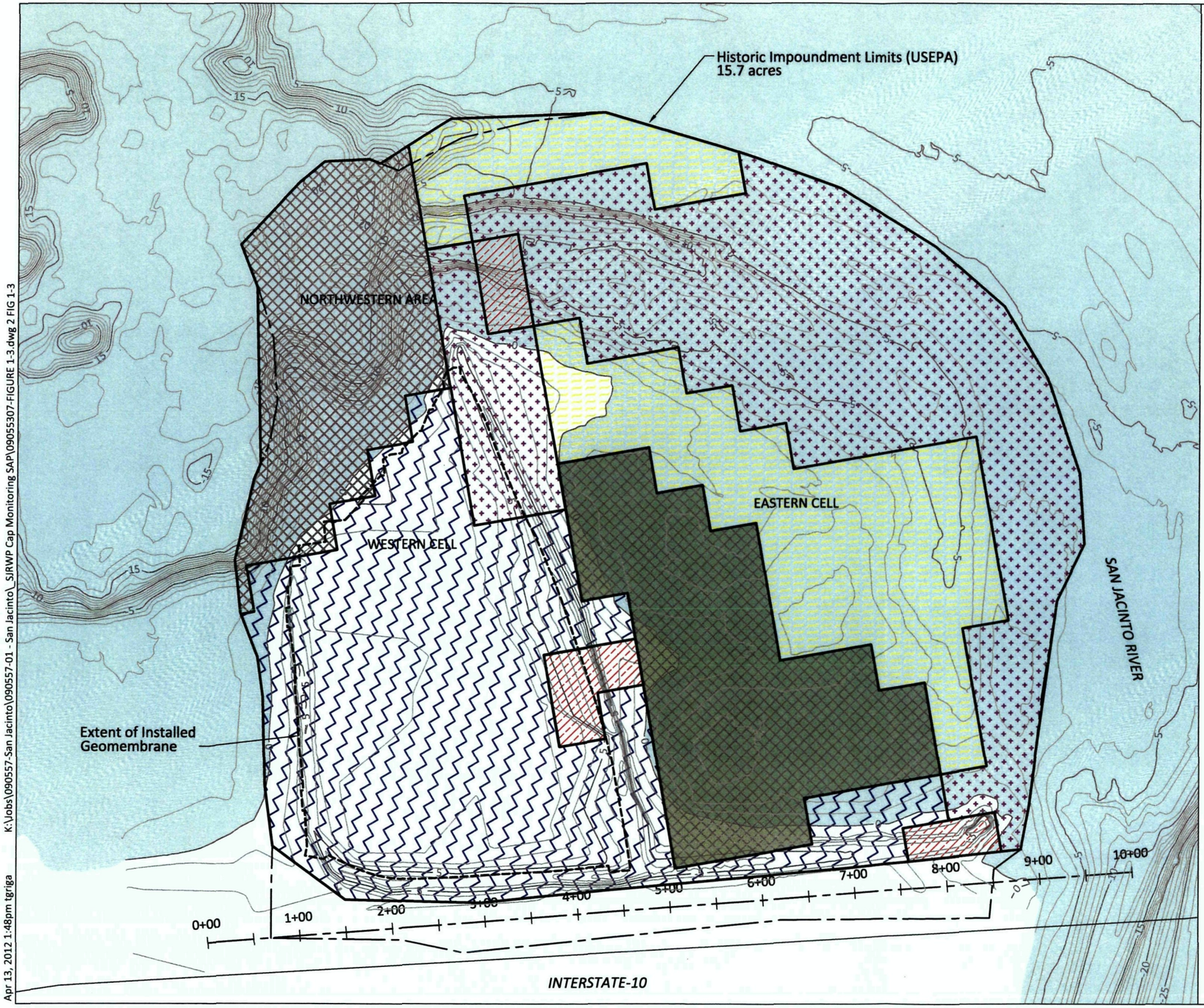


Figure 1-2
Project Organization Chart
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC



LEGEND:

- Pre-Construction Contour, 6/12/10 (1-foot interval)
- Historic Impoundment Limit (USEPA)
- Armored Cap $A_{(P)}$ (Recycled) - Without Geotextile
- Armored Cap $A_{(P)}$ (Recycled) - With Geotextile
- Armored Cap $B/C_{(P)}$ (Recycled)
- Armored Cap $C_{(N)}$ (Natural)
- Armored Cap $D_{(N)}$ (Natural)
- Armored Cap $D_{(N)}$ (Natural) (24"-Thick)
- Surveyed Extent of Installed Geotextile and Geomembrane in Western Cell

HORIZONTAL DATUM: Texas South Central, NAD83. US Survey Feet.

VERTICAL DATUM: NAVD88.

0 120
Scale in Feet

K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto_SJRWP Cap Monitoring SAP\09055307-FIGURE 1-3.dwg 2 FIG 1-3
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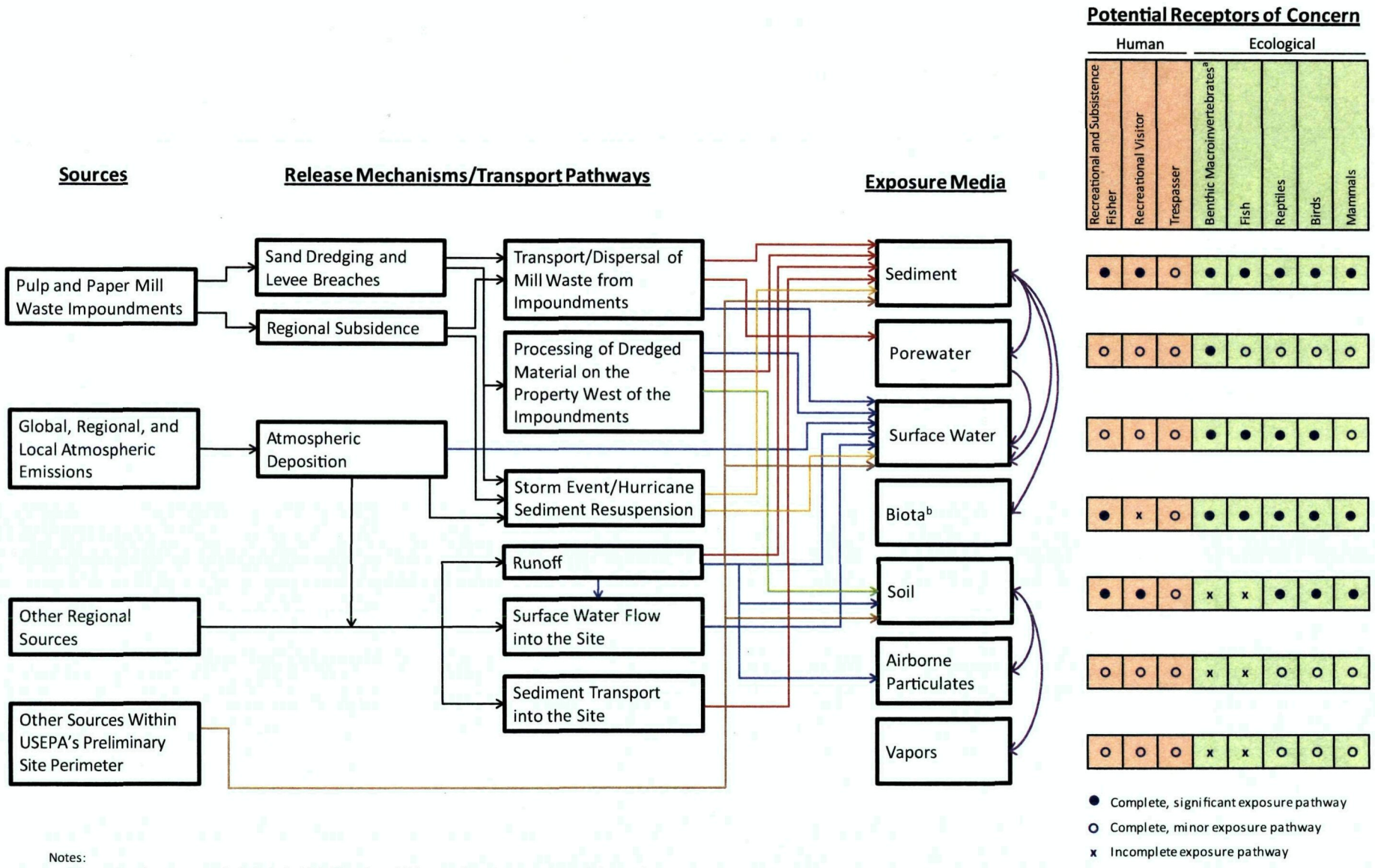
Figure 1-3
Armored Cap As-Built
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC

ANCHOR QEA integral consulting

Figure 1-4
Aerial View of TCRA Project Area, Before and After TCRA Implementation, July 14, 2011
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC



Notes:

Other regional sources may include industrial effluents, publicly owned treatment works, and stormwater.

Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.

[a]Benthic macroinvertebrates include crabs and other crustaceans and shellfish consumed by all receptors, as well as polychaetes and other infauna consumed by fish, other marine life, birds and mammals.

[b]Biota consumed by human receptors are expected to be fish and shellfish.

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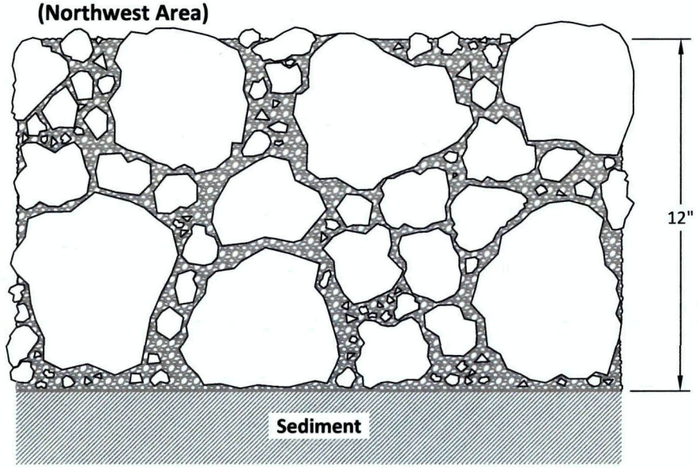
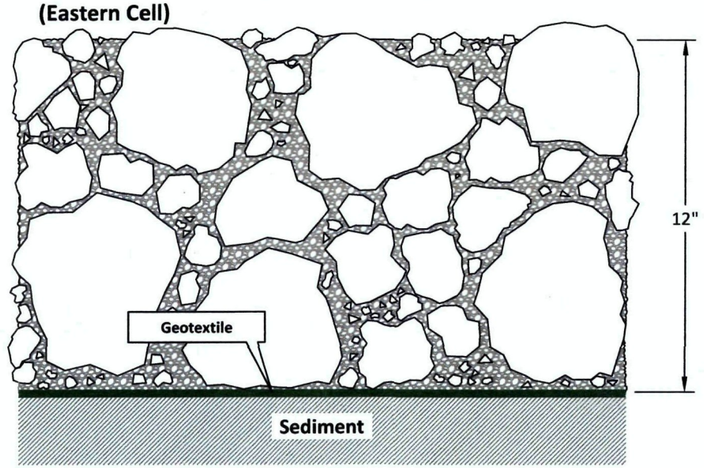
Figure 1-5

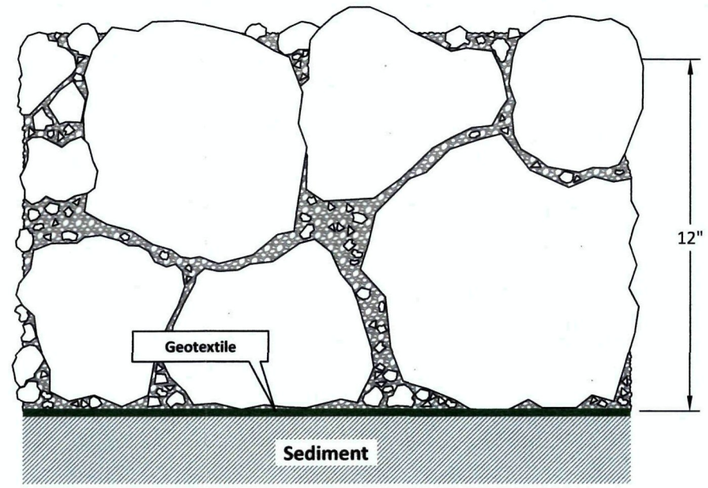
Updated Conceptual Site Model Pathways for the Area North of I-10 and Aquatic Environment

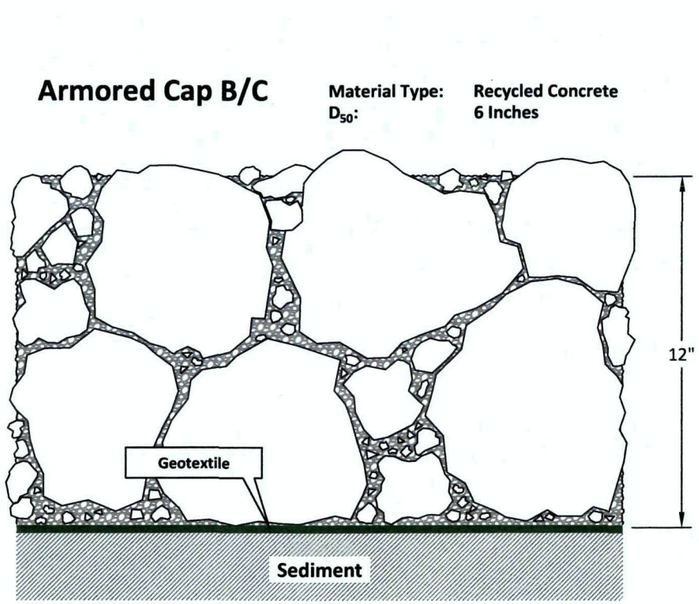
SJRWP TCRA Cap Porewater Assessment SAP

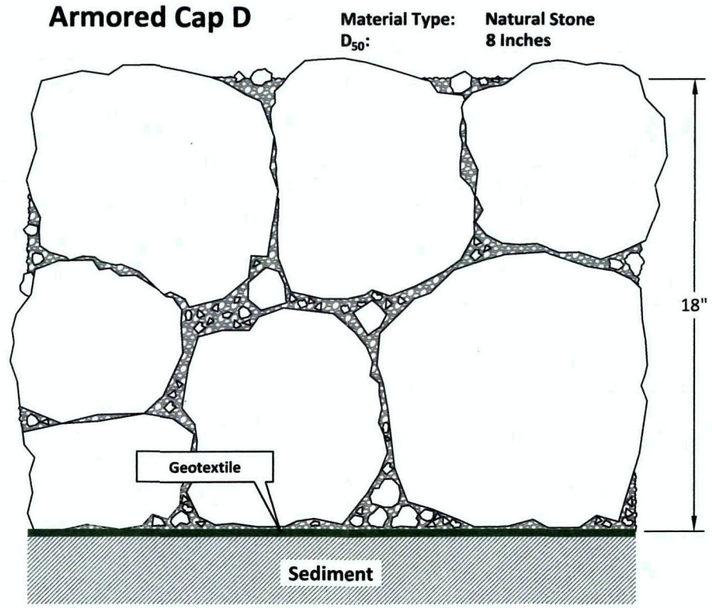
SJRWP Superfund/MIMC and IPC











NOTES:

1. Minimum thickness for each armored cap shown is 12 inches.
2. Contractor was permitted 6 inches of overplacement allowance for armored cap materials installed below an elevation of 2 feet NAVD-88.

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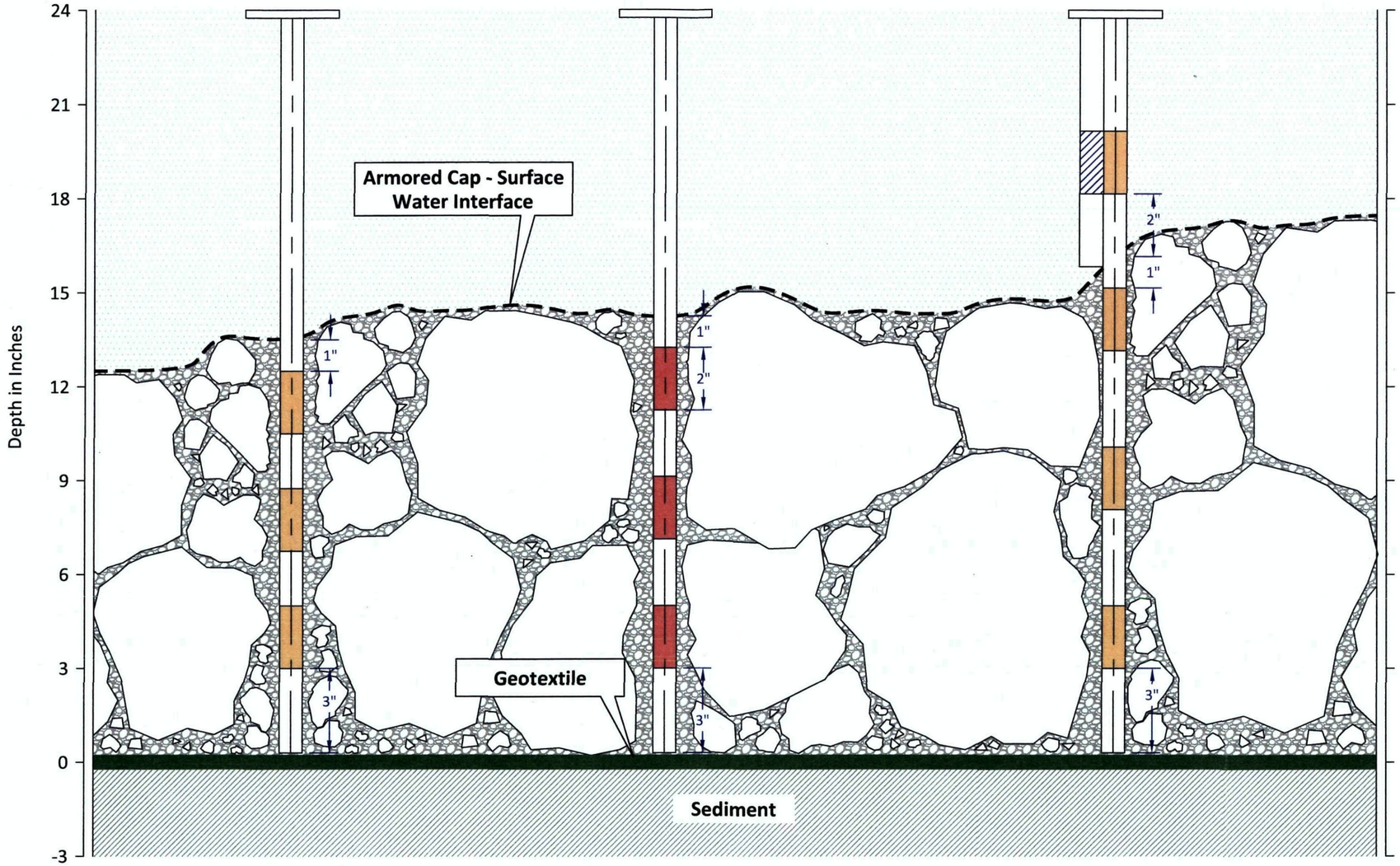
Figure 1-6
Types of Armored Cap Material
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC



LEGEND:

Porewater Sample (2-inches of SPME Fiber)

Performance Reference Compound-Impregnated Segment

Surface Water Sample

NOTES:

1. Armored cap C rock with nominal thickness of 12 inches shown.
2. Contractor was permitted 6 inches of overplacement allowance for armored cap materials installed below an elevation of 2 feet NAVD-88.

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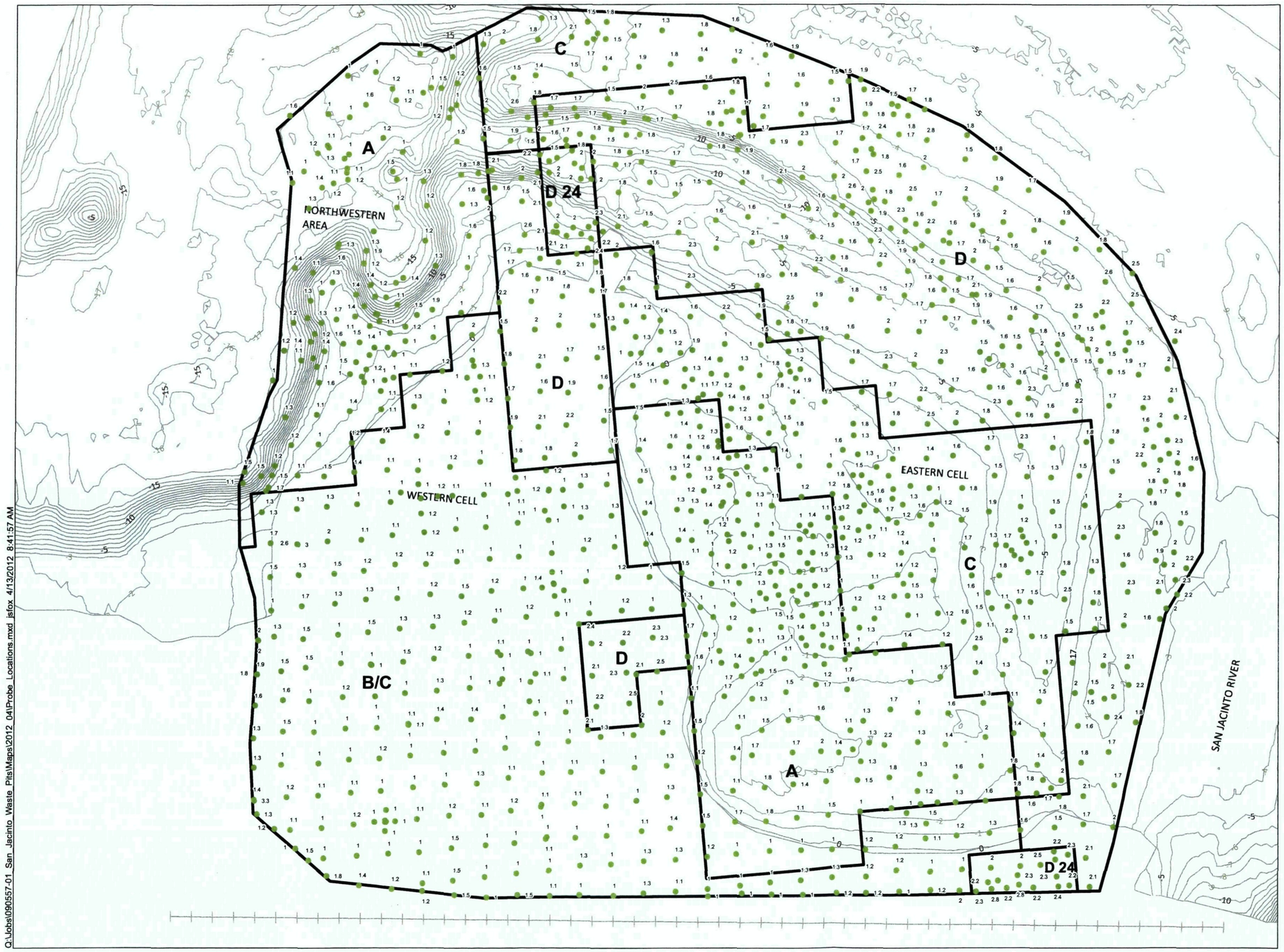
Figure 1-7
Sample Distribution Within Cap Material
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC



LEGEND

- Probing Location and Thickness; Meets or Exceeds Minimum
- Pre-Construction Contour, February 15 and 21, 2011 (1-foot interval)

Minimum Armor Thickness in Feet:

Area A	1
Area B/C	1
Area C	1
Area D	1.5
Area D24	2

Feet
0 50 100 150 200

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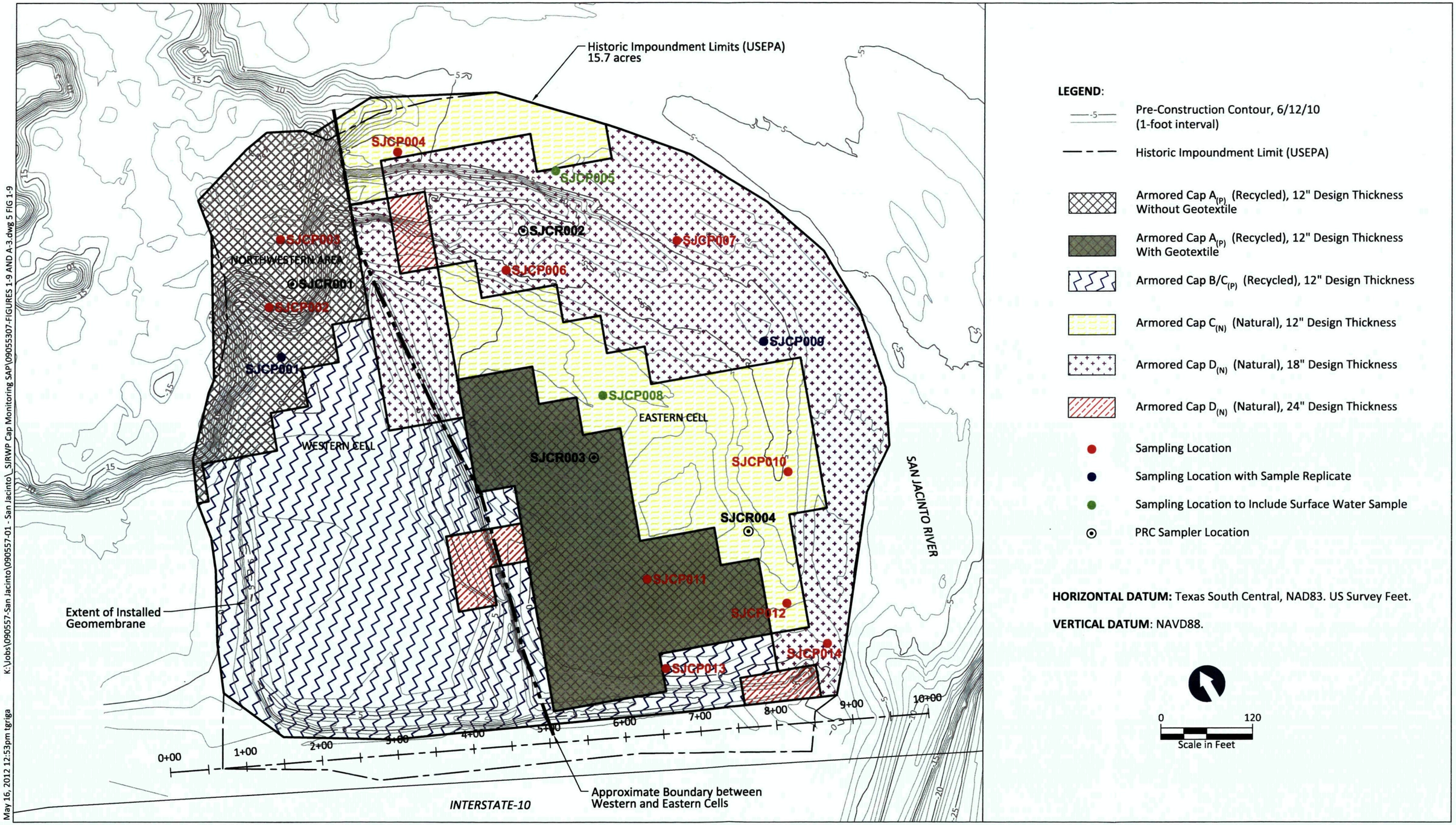
ANCHOR QEA integral consulting inc

Figure 1-8
Manual Probing Final Survey
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC



K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto_SJRWP Cap Monitoring SAP\09055307-FIGURES 1-9 AND A-3.dwg 5 FIG 1-9

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Figure 1-9
Locations of SPME Sampling Stations
SJRWP TCRA Cap Porewater Assessment SAP
SJRWP Superfund/MIMC and IPC

APPENDIX A
TCRA CAP POREWATER ASSESSMENT FIELD SAMPLING PLAN
SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

TCRA CAP POREWATER ASSESSMENT FIELD SAMPLING PLAN

SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

Prepared for

McGinnes Industrial Maintenance Corporation
International Paper Company
U.S. Environmental Protection Agency, Region 6

Prepared by

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May 2012

TABLE OF CONTENTS

List of Tables

List of Figures

List of Attachments

LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
Anchor QEA	Anchor QEA, LLC
AOC	Administrative Order on Consent
COC	chain-of-custody
DGPS	differential global positioning system
FSP	Field Sampling Plan
GPS	global positioning system
HASP	Health and Safety Plan
I-10	Interstate Highway 10
Integral	Integral Consulting Inc.
IPC	International Paper Company
MIMC	McGinnes Industrial Maintenance Corporation
NOAA	National Oceanic and Atmospheric Administration
PCDD	polychlorinated dibenzo-*p*-dioxin
PCDF	polychlorinated dibenzofuran
PDMS	polydimethylsiloxane
PRC	performance reference compounds
QA	quality assurance
QA/QC	quality assurance and quality control
QC	quality control
RI/FS	Remedial Investigation and Feasibility Study
SAP	Sampling and Analysis Plan
Site	San Jacinto River Waste Pits Superfund Site
SJRWP	San Jacinto River Waste Pits
SOP	standard operating procedure
SPME	solid-phase microextraction
TCRA	time critical removal action
UAO	Unilateral Administrative Order
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UT	University of Texas

1 INTRODUCTION

This document presents the Field Sampling Plan (FSP) that has been prepared on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC), for the cap porewater assessment at the San Jacinto River Waste Pits (SJRWP) Superfund site (the Site). This FSP was prepared consistent with U.S. Environmental Protection Agency (USEPA) guidance (USEPA 1988, 1992) and as required by the USEPA 2009 Unilateral Administrative Order (UAO), Docket No. 06-03-10, which was issued by USEPA to IPC and MIMC on November 20, 2009 (USEPA 2009). Information on geology, physiography, hydrology, and cultural and natural resources of the Site and information on fate and transport is provided in the Remedial Investigation and Feasibility Study (RI/FS) Work Plan (Anchor QEA and Integral 2010).

The Site consists of a set of impoundments, built in the mid-1960s for disposal of paper mill wastes, and the surrounding areas containing sediments and soils potentially contaminated with the waste materials that had been disposed of in the impoundments.[1] A set of impoundments approximately 14 acres in size is located on a 20-acre parcel, immediately north of the Interstate Highway 10 (I-10) Bridge over the San Jacinto River and on the river's western bank. This study addresses only the impoundments situated north of I-10.

Concurrent with the RI/FS, a time critical removal action (TCRA) was implemented by IPC and MIMC under an Administrative Order on Consent (AOC) with USEPA (Docket No. 06-12-10, April 2010; USEPA 2010). The purpose of the TCRA was to stabilize the entire area within the 1966 perimeter of the impoundments north of I-10 at the Site, abating any release of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) into the waterway from these impoundments until the Site is fully characterized and a final remedy is selected (USEPA 2010) (Figure A-1).

The primary objective of the TCRA cap porewater assessment described in this FSP is to collect information on the effectiveness of the TCRA cap. To evaluate cap performance, Anchor QEA, LLC (Anchor QEA) will conduct the fieldwork and data analysis; and Integral

[1] USEPA has identified an area south of I-10 as the location of an additional impoundment used for disposal of paper mill wastes in the 1960s, or Soil Investigation Area 4 (Integral 2011). This document does not address Soil Investigation Area 4 at all, and data collections described by this SAP will not be conducted there.

Consulting Inc. (Integral) will be responsible for coordination with the analytical laboratory, quality assurance (QA), and database management. The names and responsibilities of key project personnel for Anchor QEA and Integral who will be involved in sampling and analysis activities are provided in Figure 1-2 of the Sampling and Analysis Plan (SAP).

1.1 Overview

Interim cap performance at the Site will be evaluated by using solid-phase microextraction (SPME) sampling devices. The SPMEs contain glass fibers coated with polydimethylsiloxane (PDMS), a sorbent which will absorb any dioxin and furan congeners (as well as other hydrophobic organic compounds) present in dissolved form in the porewater of the cap, or in surface water above the cap if the polymer-coated fiber is deployed into surface water. To employ SPME technology for this study, a sampling device containing an SPME fiber is inserted into the cap material at each sampling station, the device is left in place for approximately 30 days to allow dioxins and furans dissolved in porewater to reach their equilibrium distribution between the sediment matrix and the PDMS, and the resulting concentrations of some tetrachlorinated dibenzo-*p*-dioxin (TCDD) and tetrachlorinated dibenzofuran (TCDF) congeners in the PDMS are measured. In addition to the SPME sampler containing a sample fiber at each location, a set of four samplers will contain a fiber impregnated with performance reference compounds (PRCs). The PRCs for this study are ^{13}C-labeled 2,3,7,8-TCDD and 2,3,7,8-TCDF. Because these chemicals have the same partitioning behavior into and out of the PDMS as any TCDD and TCDF that could be present in the Site surface water or cap porewater, the PRC sampler should be at least 20 feet from the any of the devices to be used to collect the sample. Separation of the two samplers will prevent the PRCs that are released from the PRC sampler from encountering the sample fiber and being absorbed into the sample. Because samplers are prepared in the laboratory, and deployed for 30 days before retrieval, two sets of chain-of-custody (COC) forms are required for each sampler, as described in Section 3.2.

Results of this study can be used to estimate porewater concentrations of the dioxins and furans using simple chemical models, as described in the SAP. Figure A-2 illustrates the configuration of the samplers in the cap material.

1.2 Document Organization

This FSP describes the field methods that will be used to collect information on cap performance. The background, rationale, data quality objectives, and overall study design are described in detail in the SAP. Section 2 of this FSP describes the field procedures and sample packaging and shipping requirements that will be followed by the technical team during the field study. Section 3 summarizes field documentation and COC procedures. Field data reporting and field custody procedures are discussed in Section 4.

The following documents are provided as attachments to this FSP:

- Cap Porewater Assessment Health and Safety Plan (HASP) Addendum 5. This document describes the specific requirements and procedures that will be implemented to minimize the safety risk to personnel who carry out the field study program for SPME placement and retrieval. It is an addendum to the project's overall HASP (Anchor QEA 2009) (Attachment A1).
- Standard Operating Procedures (SOPs). The SOPs describe the procedures that will be used for station positioning and chain-of-custody requirements for the samples. The specific method description for sampler preparation, deployment, retrieval, and processing (the SPME Method) is also included (Attachment A2).
- Field Forms. This attachment contains examples of various forms that will be used during the field work, including a corrective action record, a field change request form, and a COC form (Attachment A3).

2 SAMPLING PROCEDURES

The following sections describe the detailed procedures and methods that will be used during TCRA cap monitoring, including recordkeeping; sample handling and storage; and field quality control (QC) procedures. SPME preparation, deployment, and retrieval will be performed as described in SOP SD-20, in Attachment A2. Any modification to the procedures described in the SOPs will be documented in the field. All field activities will be conducted in accordance with the HASP and HASP Addendum 5, which is provided as Attachment A1.

2.1 Schedule

The start date for the TCRA cap porewater assessment will be determined following USEPA approval of the SAP. However, for planning purposes, it is anticipated that the field sampling event will begin in summer 2012. Samplers will be deployed for approximately 30 days.

2.2 Field Methods for Sampler Deployment

The following sections describe the sampling vessel and equipment, sampling methods, sample processing and handling, and shipping. Because this method employs the use of sensitive sampling materials in the uncontrolled field environment, thoroughness in recording deviations, field observations, time of deployment and retrieval, and other information is of the highest importance. Careful handling of the samplers to prevent contamination with atmospheric or other extraneous sources is crucial for accurate results. Two sets of COCs will be required, as described in Section 3.2.

2.2.1 Sampling Vessel, Field Equipment, and Supplies

This section describes equipment and supplies required for deployment and retrieval of SPME samplers, and is supported with additional detail in the SPME Method, in Attachment A2. Implementation of this method requires several preparatory steps, which are also described in the SPME Method.

2.2.1.1 Sampling Vessel

Access to SPME stations will require the use of a dive boat. The sampling boat or barge will have enough space to accommodate a minimum of five people (two sampling team members, two divers, and the vessel's operator[2]) and the following gear: prepared SPMEs, diving gear (as stipulated by the subcontractor), coolers, and multiple sampling equipment boxes containing sample jars and other ancillary equipment as described in SOPs. The vessels used for SPME placement and retrieval will have navigational lights and basic sonar (e.g., fathometer). The vessel will be stationary during deployment of each sampler, and the engine will be turned off during all sampler handling, deployment, and retrieval activities. The vessel will therefore be equipped with an anchor or other device to prevent drift during the sampler deployment. The vessel operator will be thoroughly familiar with the area of the river to be navigated.

Weather, river gauge height, and tides will be monitored using the following web sites:

- Weather conditions and forecasts: National Oceanic and Atmospheric Administration (NOAA) site for the Houston/Galveston area (http://www.weather.gov/forecasts/wfo/sectors/hgx.php#tabs)
- Real-time stream elevation: U.S. Geological Survey (USGS) 08072050 San Jacinto River near Sheldon, 10 miles upstream from the Site (http://waterdata.usgs.gov/nwis/uv?site_no=08072050)
- Real-time data on wind direction, wind speed, and water elevation: USGS 08077637 Clear Lake Second Outflow Channel at Kemah, 22 miles south of the Site (http://waterdata.usgs.gov/nwis/uv?site_no=08077637)
- Tides: NOAA site at Battleship Texas State Park, Station Id: 8770743, 3 miles southwest of the Site (http://tidesandcurrents.noaa.gov/noaatidepredictions/viewDailyPredictions.jsp?Stationid=8770743).

[2] If USEPA oversight is required, an additional boat will be needed.

2.2.1.2 *Field Equipment and Supplies*

Field equipment and supplies include sampling equipment, utensils, decontamination supplies, sampler containers made from decontaminated PVC tubes with caps on both ends, coolers, shipping containers, differential global positioning system (DGPS), log books and forms, personal protection equipment, and personal gear. SPME sampling devices prepared for this project according to the SPME Method are required sampling equipment. At each location, a sampler is to be deployed, either containing the actual SPME sample, or a PRC-impregnated fiber (Figure A-2). In two sampling locations and one PRC location, an auxiliary sampler will be attached to the portion of the sampler extending above the surface of the cap, for assessment of TCDD and TCDF in surface water above the cap (two locations) and for evaluation of equilibration rate (PRC location). Additional information about sampling equipment and supplies is provided in SOPs (Attachment A2).

Protective wear (e.g., nitrile gloves) is required to minimize the possibility of cross-contamination between sampling locations. Gloves will be changed between stations. Additional information on protective wear required for this project is provided in Attachment A1.

Coolers and packaging material for the samplers will be supplied by the University of Texas (UT) laboratory. Details on the numbers and type of sample containers to be provided by the analytical laboratory for use following sampler retrieval and processing are provided in Table A-1 of this FSP. In addition to the vials used by the laboratory for fiber samples following retrieval (Table A-1), containers for samplers following preparation and prior to retrieval, and for shipment to the laboratory will consist of tubes made of PVC (or a similar material) pipes with caps on each end. The UT laboratory will also supply these.

Sampling devices will be clearly labeled prior to the time of sampling, during preparation of the samplers. Labels will include the location ID, and will be cross referenced to a field logbook that indicates the task name, sample number, sampler's initials, analyses to be performed, and sample date and time. Sample numbering and identification procedures are described in detail in Sections 3.3 and 3.4.

2.2.2 Sample Location Positioning

Target locations for sampler deployment are listed in Table A-2. Actual latitude and longitude coordinates will be obtained at the locations where SPME samplers are deployed. A DGPS will be used to document the sampler deployment locations, and will be used to retrieve samplers. The standard projection method to be used during field activities is Horizontal Datum: NAD1983_StatePlane, Texas South Central, FIPS 4204, US feet. The positioning objective is to accurately determine and record the positions of all sampling locations to within ±2 m.

The DGPS unit consists of a global positioning system (GPS) receiver and a differential receiver located at a horizontal control point. At the control point, the GPS-derived position is compared with the known horizontal location, offsets or biases are calculated, and the correction factors are telemetered to the GPS receiver. Positioning accuracies on the order of ±1 to 3 m can be achieved by avoiding the few minutes per day when the satellites are not providing the appropriate quality of signal (SOP AP-06). The GPS unit provides the operator with a listing of the time intervals during the day when accuracies are decreased.

The SPME Method (Attachment A-2) includes additional detail on sample location marking (i.e., with brightly colored flagging tape) during deployment to assist divers with locating samplers during retrieval.

2.2.3 Deployment and Retrieval of SPME Samplers

SPME sampling devices (with the sample fiber or with the PRC-impregnated fiber) will be placed into the sediment at each sampling location (Figure A-3) and left in place for approximately 30 days to allow the PDMS coating on the fiber to equilibrate with the porewater. The installation of the SPME will involve use of a pilot probing rod that can be used to identify if there are significant obstructions that would prevent the installation of an SPME sampler and the thickness of a cap at each location. If significant obstructions are found during field deployment, the location may be moved laterally to find a more suitable area. The field crew will attempt to maintain all samplers within 30 feet of the preplanned locations. The exact location of each sampler will be determined using a DGPS and recorded as the samplers are installed.

In selected locations, a sampler long enough to protrude above the cap–surface water interface will be deployed, and an auxiliary sampler will be attached to the rod above the cap surface for the purposes of collecting a sample representative of surface water. This effort also requires that the surface water samplers also have a corresponding PRC-impregnated fiber, so one of the PRC samplers will also include this surface water sampler. There are four locations where PRC samplers are required (Figure A-3), one of which will have a surface water extension.

After the exposure period, the SPME sampling devices will be retrieved, individually wrapped in foil, and transported to the laboratory in specialized containers (described in Section 2.2.1.2) that are placed in coolers. Immediately after the PDMS samplers are retrieved, the samplers will be refrigerated (4±2°C). At the analytical laboratory, the samples will be removed from the sampling devices and the PDMS-coated glass fibers will be segmented and the segments will be analyzed for concentrations of TCDD and TCDF or PRCs. Immediately after sample containers are filled at the analytical laboratory and prior to analysis, the samples will be refrigerated (4±2°C).

A detailed description of the SPME sample collection method that will be used for this study, including the equipment and procedures that will be used to prepare, deploy, and retrieve porewater samplers, resulting in PDMS-coated fiber samples to be analyzed for TCDD and TCDF or PRCs, is provided in the SPME Method, in Attachment A2. The numbers of field locations that will be sampled are listed in Table A-3 and shown in Figure A-3. The containers for the fiber samples, and preservation and holding time requirements for the samples following field collection are specified in Table A-1.

Anchor QEA's field lead and field personnel in charge of sample handling will ensure that all procedures for deployment and retrieval at each station are followed and that the appropriate sample container is used for each sample.

2.2.4 Equipment Decontamination

Decontamination procedures are needed in the laboratory for preparation of the SPME samplers prior to their assembly, for the sampler containers used for storage and transport,

and for the column cutter used to section the fibers in the analytical laboratory. Decontamination of the samplers prior to assembly, the sampler containers, and of the cutters is described in the SPME Method. Prior to each cut of a fiber from within a sampler, and between samplers, column cutters will be will be scrubbed with a standard detergent (e.g., Alconox® or Liquinox®), rinsed with water (potable, deionized, or distilled), and rinsed with laboratory-grade distilled or deionized water. After cleaning, if the cutter is not being used, the decontaminated cutter will be covered with aluminum foil to protect it from possible contamination. This same procedure is used to decontaminate the modified piezometers used to assemble the samplers during preparation, but is followed by a drying step (the SPME Method).

2.3 Field Quality Control Samples

Quality assurance and quality control (QA/QC) samples will be collected in all major steps of this study (Table A-4). These steps will include the following:

- Samples collected during the preparation of the sampling apparatus to ensure that chemicals detected in samples after exposure in the field did not come from the original fibers themselves or from elements of the sampling apparatus such as caulk.
- Samples collected during sampler deployment to ensure that contamination is not introduced during the procedure of installing the SPME sampling devices.
- Samples collected during sampler retrieval to ensure that contamination is not introduced during the procedures of collecting the samplers in the field.
- Replicate samples to assess the variability of the results of samples in the field.
- Preparation of materials to support laboratory internal quality control samples, including blank spikes, blank spike duplicates, and blank samples.

2.4 Sample Packaging and Transport

As mentioned above, sample coolers and packing materials will be supplied by the laboratories. Prepared samplers will be handled only with nitrile-gloved hands following decontamination and will be wrapped in aluminum foil prior to storage in container tubes that have been decontaminated in preparation for deployment. Before taking the retrieved SPME sampling device from the diver, sampling personnel will put on a new, clean pair of nitrile gloves at each station. The tag affixed to the handle of the SPME sampling device will

be checked to confirm the station number. The SPME will be immediately wrapped in clean aluminum foil, placed in an airtight container and stored in a cooler on ice at 4±2°C. To prevent confusion at the analytical laboratory, PRC samplers will be stored in a separate, labeled container following retrieval. This container will contain only PRC samples.

Ice in sealed plastic bags will then be placed in the cooler to maintain a temperature of 4°C (±2°C). When the cooler is full, the COC form will be placed into a zip-locked bag and taped to the inside lid of the cooler. A temperature blank will be added to each cooler. Each cooler will be sealed with two COC seals, one each on the front and side of the cooler. Labels indicating "This End Up "with an arrow and "Fragile" will be attached to each cooler.

The shipping containers will be clearly labeled (i.e., name of task, time and date container was sealed, person sealing the cooler, and company name and address) for positive identification. These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24). Coolers containing samples for chemical analyses will be transported to the laboratory by the Anchor QEA field lead or his designee.

After the chemistry samples have been received by the analytical laboratory, they will be stored at (4±2°C) and processed as soon as possible after receipt by the laboratory.

2.5 Study-Derived Wastes

During field work, only disposable materials used for sample collection and processing, such as paper towels and gloves, will be generated by this sampling program. Such wastes will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the Site by sampling personnel and placed in a normal refuse container for disposal at a solid waste landfill. No contaminated soil or sediment requiring disposal, and no hazardous materials will be used during field work for this study. Any hazardous materials used during sample processing will be disposed by the laboratories according to standard laboratory waste handling protocols.

3 FIELD DOCUMENTATION

The integrity of each sample from the time of deployment (the SPME Method) to the point of data reporting must be maintained. Proper record-keeping and COC procedures will allow samples to be traced from deployment to final disposition. Photographs will also be taken of samplers pre-deployment (i.e., during preparation of the SPMEs at the UT laboratory). Representative photographs of samplers from various angles and close-up views of the overall conditions in the field will also be collected, both during deployment and retrieval. It will not be possible to collect photographs of the samplers in the cap following deployment because the San Jacinto River is turbid.

3.1 Field Logbook

All field activities and observations will be noted in a log book. The field logbook will be a bound document. Information will include personnel, date, time, station designation, sampler, types of samples collected, and general observations. Any changes that occur during sampling (e.g., personnel, responsibilities, or deviations from the FSP) and the reasons for these changes will be documented. The logbook will identify on-site visitors (if any) and the number of photographs taken at each sampling location. Each field lead is responsible for ensuring that their respective field logbook and all field data forms are correct. Requirements for logbook entries will include the following:

- Logbooks will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, will be prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be recorded, as well as the time of the observation itself).
- Each consecutive day's first entry will be made on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 for 9:00 a.m. and 2100 for 9:00 p.m.), will appear on each page.

In addition to the preceding requirements, the person recording the information must initial and date each page of the field logbook. If more than one individual makes entries on the

same page, each recorder must initial and date each entry. The bottom of the page must be signed and dated by the individual who makes the last entry.

Logbook corrections will be made by drawing a single line through the original entry, allowing the original entry to be read. The corrected entry will be written alongside the original. Corrections will be initialed and dated and may require a footnote for explanation.

The type of information that may be included in the field logbook and/or field data forms includes the following:

- Task name, task location, and task number
- Task start date and end date
- Weather conditions
- Name of person making entries and other field staff
- On-site visitors, if any
- Sampling vessel, if any
- Station number and location
- Date and collection time of each sample
- The sample number for each sample to be submitted for laboratory analysis
- The specific date and time with corresponding station number associated with the sampling location coordinates derived from DGPS
- Observations of any large boats or other vessels active nearby the sampling area during deployment or retrieval
- The sample number, date and time of collection, equipment type, and the lot number for the box of filter papers used for field QC samples
- Observations made during sample collection, including weather conditions, complications, and other details associated with the sampling effort
- Station description (presence of anthropogenic material, and presence and type of biological structures, other debris, oil sheens, and odor)
- Sediment penetration depth (nearest 0.5 cm)
- Any surface vegetation or debris that is removed by the divers from the sampling location prior to sampler deployment
- The number of photographs taken at the sampling location

- A record of Site health and safety meetings, updates, and related monitoring
- Any deviation from the FSP and reasons for deviation.

In addition, a sampling location map will be updated during sampling and will be maintained throughout the sampling event. All logbooks must be completed at the time that any observations are made. Copies of all logbooks and forms will be retained by the technical team.

3.2 Chain-of-Custody Procedures

Two sets of COC will be required for this study:

- COCs prepared at the time of the sampler assembly and completed at the time of sampler deployment
- COCs prepared upon retrieval, and completed at the analytical laboratory.

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals (see SOP AP-03). A COC record will be signed by each person who has custody of the samplers and will accompany the samplers at all times. Copies of the COC will be included in laboratory and QA/QC reports. Attachment A3 contains an example of the COC form that will be used during the 2012 TCRA cap porewater study.

At a minimum, the form will include the following information:

- Site name
- Field lead's name and team members responsible for collection of the listed samples
- Collection date and time for each sample
- Sample type (i.e., sample for immediate analysis or archive)
- Number of sample containers shipped
- Requested analyses
- Sample preservation information (if any)
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility.

Following sampler assembly through deployment, the SPME laboratory coordinator will be the designated sampler custodian. During retrieval and transport to the analytical laboratory, Anchor QEA's field lead (or delegate) will be the designated field sample custodian. Sampler custodians will be responsible for all sample tracking and COC procedures for the samples that their respective teams collected in the field. The SPME laboratory coordinator will be responsible for initial sampler inventory and will maintain sampler integrity and documentation of sampler custody. Upon transferring samplers to the field sampler custodian (Anchor QEA's field lead), the SPME laboratory coordinator custodian will sign, date, and note the time of transfer on the COC form to Anchor QEA. The field sampler custodian will be responsible for final sampler inventory and will maintain sample custody documentation. The field sampler custodian will complete COC forms prior to removing samplers from the field. Upon transferring samplers to the laboratory sample custodian (if a local laboratory is selected) or shipping courier (as appropriate), the field sampler custodian will sign, date, and note the time of transfer on the COC form. The original COC form will be transported with the samples to the laboratories. All samples will be shipped to the testing laboratories in either coolers or shipping containers sealed with custody seals.

Each laboratory will designate a sampler or sample custodian who will be responsible for receiving samplers and documenting their progress through the laboratory analytical process. The sample custodian for each laboratory will establish the integrity of the custody seals upon sample arrival at the laboratory. The laboratory sample custodian will also ensure that the COC and sample tracking forms are properly completed, signed, and initialed upon receipt of the samples.

When the laboratory receives the samplers, the laboratory sample custodian will conduct an inventory by comparing sampler labels to those on the COC document. The custodian will enter the sampler and sample number into a laboratory tracking system by task code and sample designation. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or for storing samples at the correct temperature in an appropriate secure area.

3.3 Station Numbering

All stations will be assigned a unique identification code based on a designation scheme designed to suit the needs of the field personnel, data management, and data users. Station numbers will include "SJ" to indicate San Jacinto followed by a two-letter code for the type of sample to be collected at a given location (CP = cap porewater). The letters will be followed by a three-digit number (e.g., 001, 002, or 003). The station numbers will increase as the stations move upstream. An example station number for the 2012 TCRA cap monitoring study would be SJCP003.

Station numbers will not be recorded on sample labels or COC forms to prevent analytical laboratories from seeing the relationships between samples and stations.

3.4 Sample Identifiers

Each SPME sampler from a given station will have a unique label identifier. Sample identifiers will be established before field sampling begins and assigned to each sampler prior to deployment and confirmed as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., field split samples) to ensure proper data analysis and interpretation; 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples; and 3) to track individual sample containers to ensure that the laboratory receives all of the material associated with a single sample. To accomplish these purposes, each container is assigned a sample number and a tag number. These codes and their uses are described below:

- A sample identifier for each surface sample will be created as follows: the station number (e.g., SJCP003, Figure A-3), followed by a two-letter code for the kind of sample collected at a given location (SP = SPME), this will be followed by a number to indicate the kind of sampler (i.e., 1= Sample, 2= PRC impregnated). In addition, samples collected from different lengths of glass fibers will also have a final alpha character attached to the sample identifier that will distinguish between the different sample intervals (e.g., A = 0–3 inches from the top of the cap, 1 inch below the surface water interface, B = center sample in the column, C = 3 inches from the bottom of the sampler, and W = surface water sample). Example sample identifiers for a SPME sample from the 0–3 inch interval and its collocated field replicate would be SJCP003-

SP1A and SJCP003-SP1A-DUP. An example sample identifier for a PRC-impregnated segment paired with this sampler but from the center sample would be SJCP003-SP1B.

- The sample number is an arbitrary number assigned to each SPME sample collected (e.g., SP0001, SP0002) for chemical analysis. All subsamples of a composited field sample will have the same sample number. Each field split sample and each field triplicate will have a different sample number, and the sample numbers of related field QC samples may not share any content. The sample number appears on the sample containers and the COC forms.
- A unique numeric sample tag number will be attached to each sample container. If the amount of material (i.e., everything associated with a single sample number) is too large for a single container, each container will have the same sample number and a different sample label with a unique sample tag number. A sample will also be split between containers if a different preservation technique is used for each container (i.e., because different analyses will be conducted). The sample tag number will appear on the COC forms. Tag numbers are used by laboratories only to confirm that they have received all of the containers that were filled and shipped. Data are reported by sample number.

Sample numbers will be assigned sequentially in the field, and sample labels will be preprinted with tag numbers.

For equipment filter wipe blanks, sequential numbers starting at 900 will be assigned instead of station numbers. For example, the equipment filter wipe blank for a SPME will be labeled as SPFW-901, whereas the filter blank will be labeled as SPFB-901 (where FW = filter wipe and FB = filter blank).

4 FIELD DATA MANAGEMENT AND REPORTING PROCEDURES

During field operations, effective data management is critical to providing consistent, accurate, and defensible data and data products. Daily field records (a combination of field logbooks, field forms, if any, and COC forms) will make up the main documentation for field activities. Upon completion of sampling, field notes, data sheets (if any), and COC forms will be scanned to create an electronic record. Field data will be manually entered into the project database. One hundred percent of the transferred data will be verified based on hard copy records. Electronic QA checks to identify anomalous values will also be conducted following entry.

5 REFERENCES

Anchor QEA, 2009. Health and Safety Plan San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, Ocean Springs, MS.

Anchor QEA and Integral, 2010. Final Remedial Investigation/Feasibility Study Work Plan, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper, and U.S. Environmental Protection Agency, Region 6. Anchor QEA, Ocean Springs, MS, and Integral Consulting Inc., Seattle, WA. November 2010.

Integral, 2011. Sampling and Analysis Plan: Soil Study, Addendum 1, San Jacinto River Waste Pits Superfund Site. Prepared for McGinnes Industrial Maintenance Corporation, International Paper Company, and U.S. Environmental Protection Agency, Region 6. Integral Consulting Inc., Seattle, WA. March, 2011.

USEPA, 1988. Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA, 1992. Guidance for Data Usability in Risk Assessment. Parts A and B. Final. Publication 9285.7-09. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA, 2009. Unilateral Administrative Order for Remedial Investigation/Feasibility Study. U.S. EPA Region 6 CERCLA Docket No. 06-03-10. In the matter of: San Jacinto River Waste Pits Superfund Site Pasadena, Texas. International Paper Company, Inc. & McGinnes Industrial Management Corporation, respondents.

USEPA, 2010. *Administrative Settlement Agreement and Order on Consent for Removal Action.* U.S. Environmental Protection Agency, Region 6 CERCLA Docket No. 06-03-10. In the matter of: San Jacinto River Waste Pits Superfund Site Pasadena, Harris County, Texas. International Paper Company, Inc. & McGinnes Industrial Management Corporation, respondents.

TABLES

Table A-1

Sample Containers,[a] Preservation, and Holding Time Requirements

Parameter	Laboratory	Container		Preservation	Holding Time
		Type	Size		
Dioxins/furans	ALS-Columbia - Houston	AG Vial	2 mL	4±2°C	6 months [b] 1 year [c]
$^{13}C_{12}$ -labeled dioxins and furans	ALS-Columbia - Houston	AG Vial	2 mL	4±2°C	6 months [b] 1 year [c]

Notes

AG = amber glass

a - Solid-phase microextraction samplers will be stored in containers consisting of a PVC (or similar) pipe with cap on both ends. These will be decontaminated prior to use following sampler assembly and prior to sampler retrieval.

b - Holding time prior to extraction

c - Holding time for extracts

Table A-2
Sampling Location Coordinates

Name	X	Y
SJCP001	3216897.77337	13857775.69500
SJCP002	3216916.37960	13857840.67460
SJCP003	3216973.61159	13857909.98880
SJCP004	3217164.77768	13857931.61640
SJCP005	3217332.47733	13857805.89160
SJCP006	3217211.38503	13857726.25620
SJCP007	3217425.07137	13857647.29020
SJCP008	3217239.50460	13857519.90670
SJCP009	3217458.48268	13857475.25310
SJCP010	3217400.93060	13857311.45100
SJCP011	3217169.70136	13857282.32860
SJCP012	3217313.67886	13857162.87290
SJCP013	3217132.77283	13857168.72360
SJCP014	3217333.41519	13857090.65000
SJCR001	3216959.39662	13857851.02180
SJCR002	3217257.08001	13857759.18880
SJCR003	3217189.46253	13857455.35280
SJCR004	3217318.03255	13857269.81470

Notes
Datum: NAD83; State Plane Texas S. Central FIPS 4204 (feet)

Table A-3

Sampling Locations, Methods, and Analytes[a]

Sample Group	Sampling Method and Depth	Number of Locations	Sample Locations	Analytes	Study Elements
On-site TCRA cap monitoring stations	Sampling depth will vary based on the thickness of the cap at any given station; multiple samples will be collected at each station	14	Within the TCRA cap	TCDD, TCDF	Fate and transport and conceptual site model, engineering construction evaluation
		4		$^{13}C_{12}$-labeled TCDD and TCDF will be analyzed as performance reference compounds	

Notes

PCDD = polychlorinated dibenzo-*p*-dioxin
PCDF = polychlorinated dibenzofuran
SPME = solid-phase microextraction
TCRA = time critical removal action

a - Numbers do not include field quality control samples.

Table A-4
Summary of Quality Control Samples

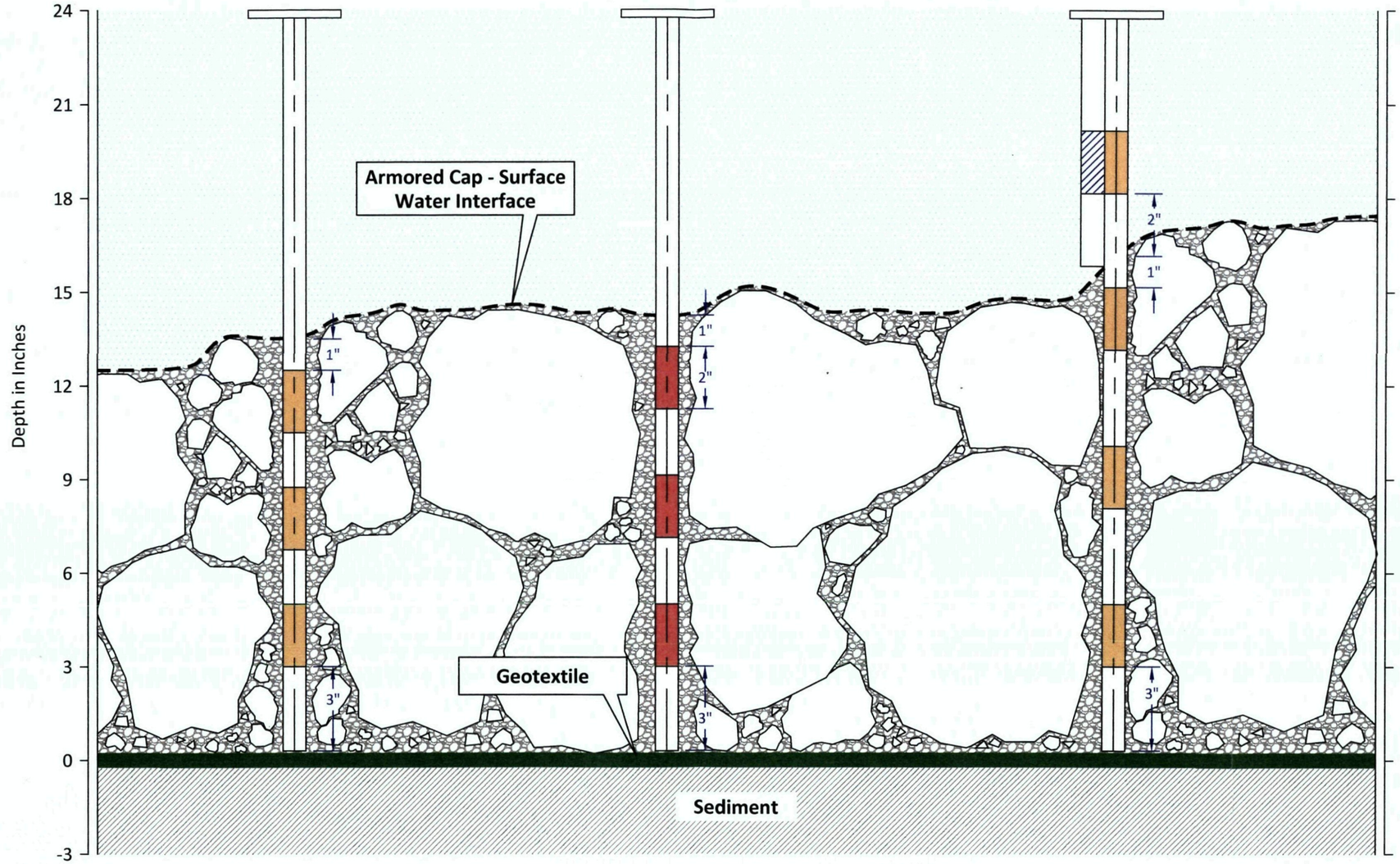
Study Stage	QA/QC Sample Types	Purpose	Number
Sampler Preparation	Caulk Blank	Ensure caulk used in samplers does not contribute TCDD and TCDF to final sample	1
	SPME Blank	Ensure fibers do not contain TCDD and TCDF prior to deployment	1
	Solvent Rinse Blank	Ensure that decontamination of samplers prior to deployment is effective	2
	Fibers for Laboratory QC	Provide materials for laboratory internal matrix-specific quality control	Three 5-cm long fibers
Sampler Deployment	Field Replicate Samples	Assess field variability	2
	Environmental Blank	Assess if atmospheric contamination of SPME occurs during sampler deployment	1
Sampler Retrieval	Environmental Blank	Assess if atmospheric contamination of SPME occurs during sampler retrieval	1
	Temperature Blanks	Ensure that samples maintain proper temperature	One per shipping cooler

Notes

QC = quality control
SPME = solid-phase microextraction
TCDD = 2,3,7,8-tetrachlorodibenzo-*p*-dioxin
TCDF = 2,3,7,8-tetrachlorodibenzofuran

FIGURES

Figure A-1
Aerial View of TCRA Project Area, Before and After TCRA Implementation, July 14, 2011
SJRWP TCRA Cap Porewater Assessment FSP
SJRWP Superfund/MIMC and IPC



LEGEND:

- Porewater Sample (2-inches of SPME Fiber)
- Performance Reference Compound-Impregnated Segment
- Surface Water Sample

NOTES:

1. Armored cap C rock with nominal thickness of 12 inches shown.
2. Contractor was permitted 6 inches of overplacement allowance for armored cap materials installed below an elevation of 2 feet NAVD-88.

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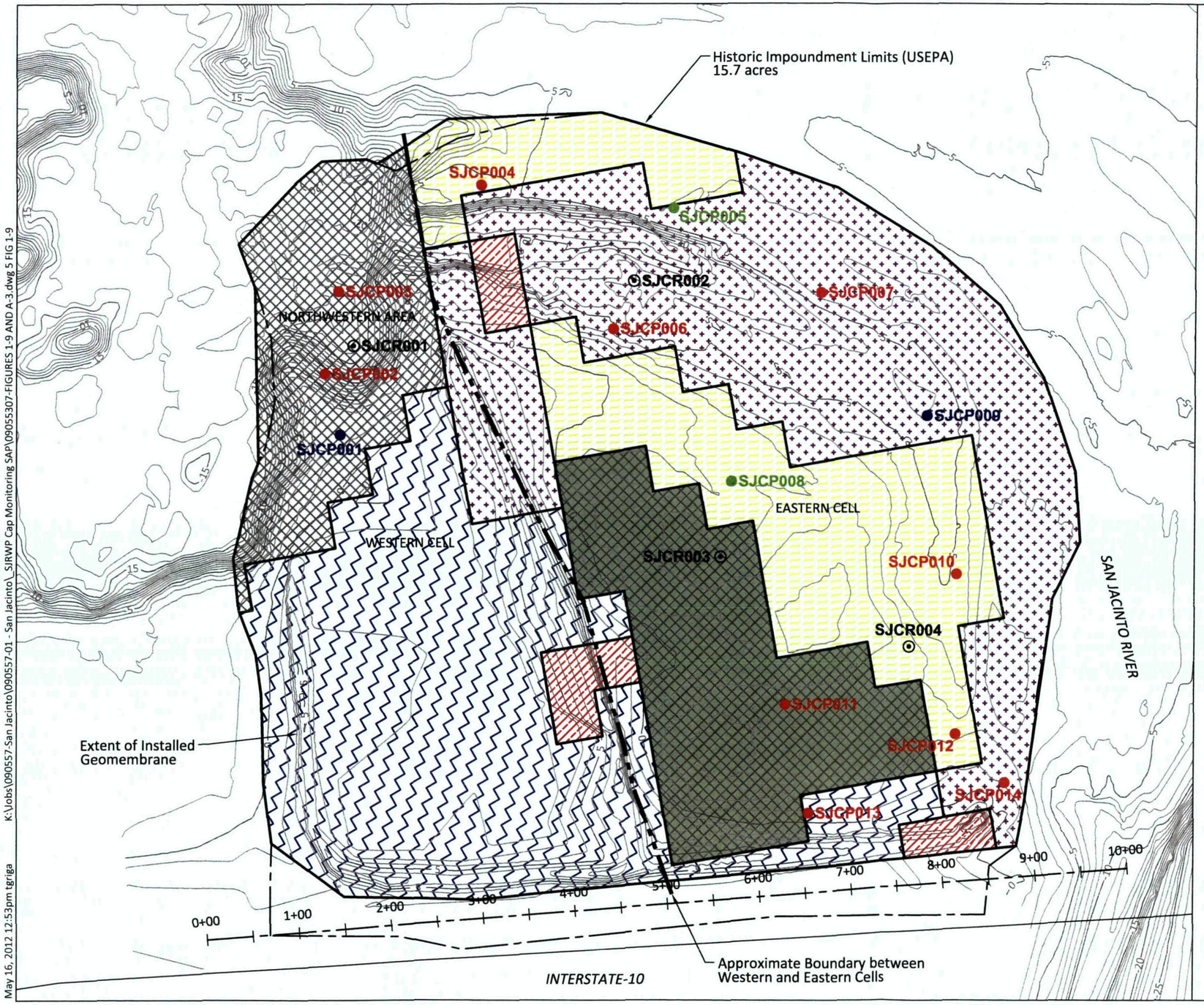
Figure A-2
Sample Distribution Within Cap Material
SJRWP TCRA Cap Porewater Assessment FSP
SJRWP Superfund/MIMC and IPC



LEGEND:

- Pre-Construction Contour, 6/12/10 (1-foot interval)
- Historic Impoundment Limit (USEPA)
- Armored Cap $A_{(P)}$ (Recycled), 12" Design Thickness Without Geotextile
- Armored Cap $A_{(P)}$ (Recycled), 12" Design Thickness With Geotextile
- Armored Cap $B/C_{(P)}$ (Recycled), 12" Design Thickness
- Armored Cap $C_{(N)}$ (Natural), 12" Design Thickness
- Armored Cap $D_{(N)}$ (Natural), 18" Design Thickness
- Armored Cap $D_{(N)}$ (Natural), 24" Design Thickness
- Sampling Location
- Sampling Location with Sample Replicate
- Sampling Location to Include Surface Water Sample
- PRC Sampler Location

HORIZONTAL DATUM: Texas South Central, NAD83. US Survey Feet.

VERTICAL DATUM: NAVD88.

0 120
Scale in Feet

K:\Jobs\090557-San Jacinto\090557-01 - San Jacinto_SJRWP Cap Monitoring SAP\09055307-FIGURES 1-9 AND A-3.dwg 5 FIG 1-9
May 16, 2012 12:53pm tgriga

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Figure A-3
Locations of SPME Sampling Stations
SJRWP TCRA Cap Porewater Assessment FSP
SJRWP Superfund/MIMC and IPC

ATTACHMENT A1
ADDENDUM 5 TO THE OVERALL HEALTH AND SAFETY PLAN: TCRA CAP POREWATER ASSESSMENT HEALTH AND SAFETY PLAN

ADDENDUM 5 TO THE OVERALL HEALTH AND SAFETY PLAN: TCRA CAP POREWATER ASSESSMENT HEALTH AND SAFETY PLAN

Prepared for

McGinnes Industrial Maintenance Corporation

International Paper Company

Prepared by

Anchor QEA

614 Magnolia Avenue

Ocean Springs, Mississippi 39564

May 2012

CERTIFICATION PAGE

Addendum 5 to the overall Health and Safety Plan (HASP; Anchor QEA 2009) for the San Jacinto River Waste Pits Superfund Site (the Site) has been reviewed and approved by Anchor QEA, LLC (Anchor QEA) for the 2012 TCRA Cap Porewater Assessment field work at the Site in support of the Remedial Investigation and Feasibility Study (RI/FS) for the Site.

David Keith	David Keith
Project Manager	Field Lead
Anchor QEA, LLC	Anchor QEA, LLC
Date: _____	Date: _____

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

Project Name: San Jacinto River Waste Pits Superfund Site

Addendum 5 to the overall HASP (Anchor QEA 2009) is approved by Anchor QEA for use at the San Jacinto River Waste Pits Superfund Site (the Site). The overall HASP and Addendum 5 are the minimum health and safety standard for the Site and will be strictly enforced for Anchor QEA personnel and other consulting personnel including subcontractors where applicable.

I have reviewed Addendum 5, dated May 2012, to the overall HASP for the Site. I have had an opportunity to ask any questions I may have and have been provided with satisfactory responses. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of Anchor QEA, or its subcontractors.

Date	Name (print)	Signature	Company

Date	Name (print)	Signature	Company

SITE EMERGENCY PROCEDURES

Emergency Contact Information

Table A

Site Emergency Form and Emergency Phone Numbers

Category	Information	
Chemicals of Potential Concern	Dioxins/furans, aluminum, magnesium, mercury, and copper	
Minimum Level of Protection	Level D	
Site(s) Location Address	(No formal address, see Figure A) Channelview, TX 77530 Coordinates [29° 47' 38.49"N, 95° 3' 49.55"W]	
Emergency Phone Numbers		
Ambulance	911	
Fire	911	
Police	911	
Poison Control	911 and then 1-800-222-1212 if appropriate	
Project-Specific Health and Safety Officers' Phone Numbers		
Anchor QEA PM and FL	David Keith	Office: (228) 818-9626 Cell: (228) 224-2983
Anchor QEA SSO	Chris Torell	Office: (315) 453-9009 ext. 17 Cell: (315) 254-4954
Anchor QEA CHSM	David Templeton	Office: (206) 287-9130 Cell: (206) 910-4279
Client Contact – International Paper Company (IPC)	Philip Slowiak	Office: (901) 419-3845 Cell: (901) 214-9550
Client Contact – McGinnes Industrial Maintenance Corporation (MIMC)	David Moreira	Office: (603) 929-5446
Reporting Oil and Chemical Spills		
National Response Center	1-800-424-8802	
State Emergency Response System	(512) 424-2138	
USEPA Environmental Response Team	(201) 321-6600	

Note: In the event of any emergency, contact the Anchor QEA PM/FL.

Figure A

Site Location Map

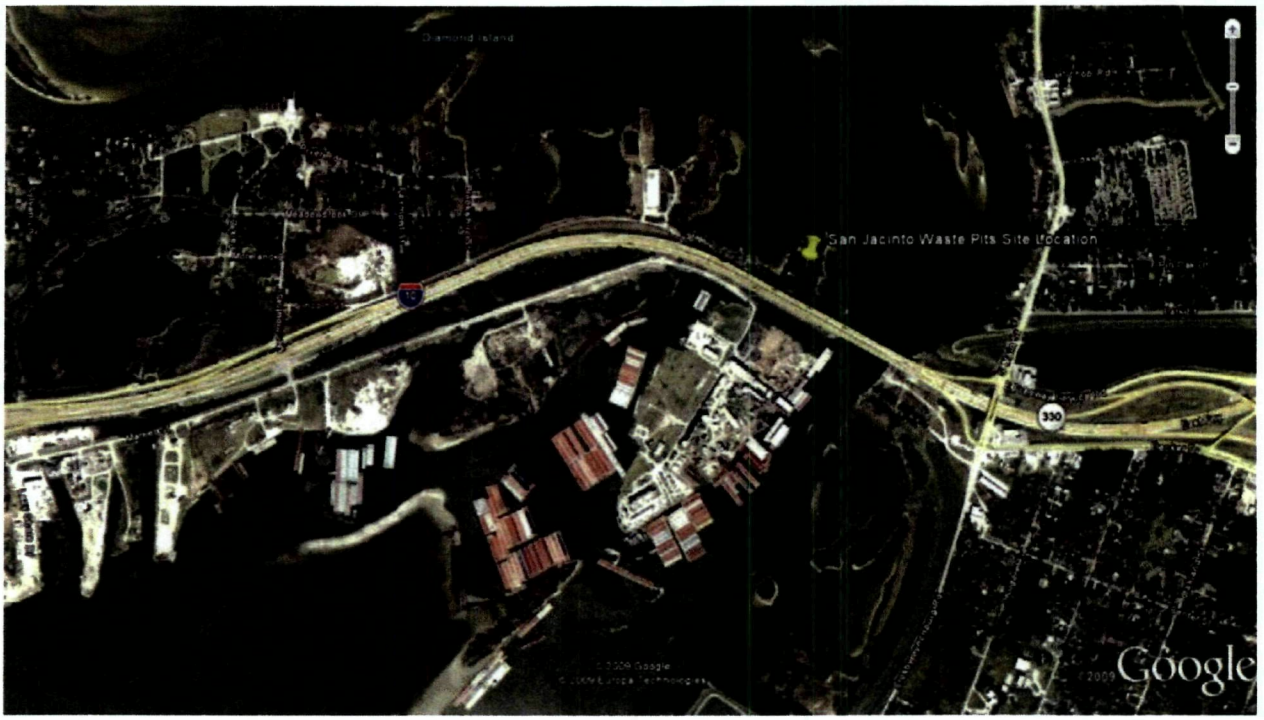


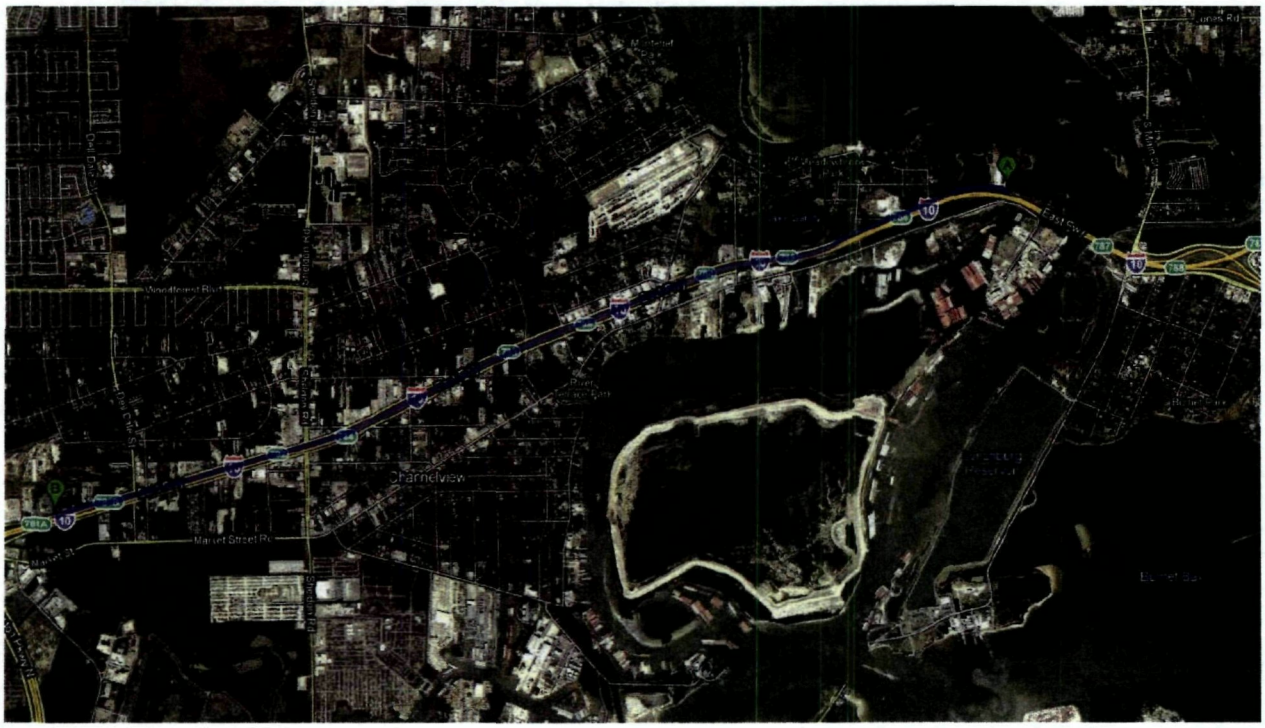
Table B

Hospital Information

Category	Information
Hospital Name	Triumph Hospital – East Houston
Address	15101 East Freeway
City, State	Channelview, TX 77530-41041
Phone	(713) 691-6556
Emergency Phone	(713) 691-6556

Figure B

Hospital Route Map

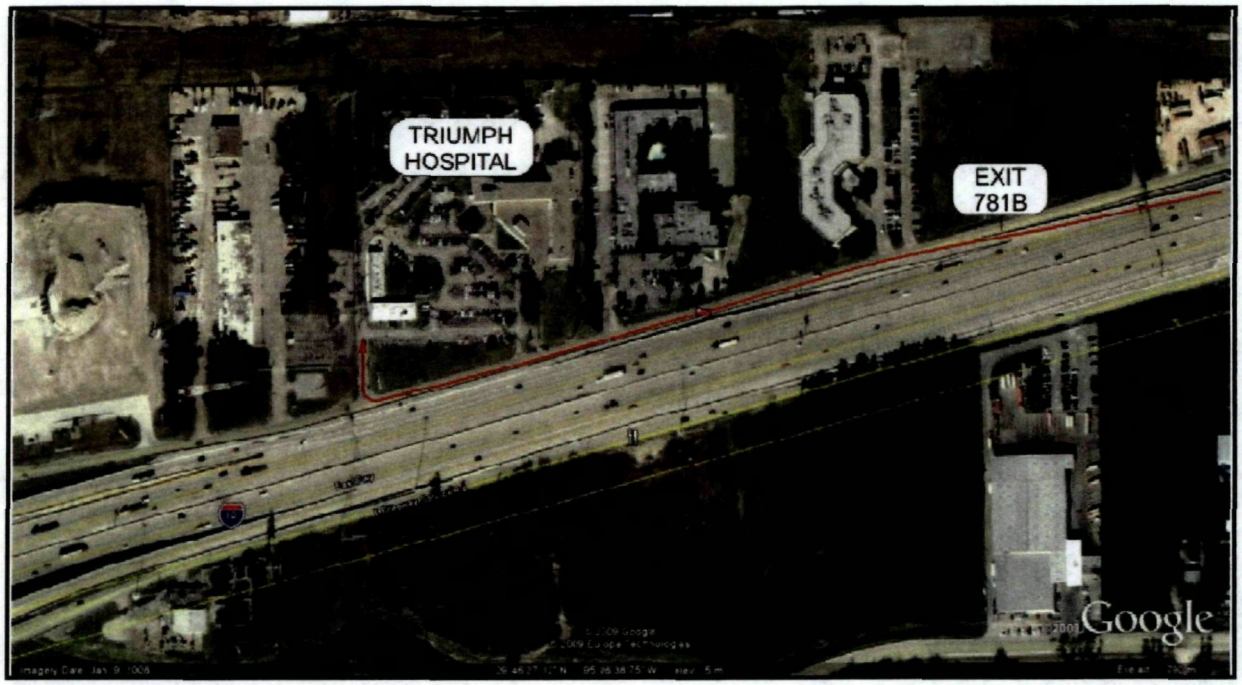


DRIVING DIRECTIONS FROM SITE TO HOSPITAL

1. Head west on East Freeway Service Road toward Monmouth Street (approximately 0.9 miles).
2. Take the ramp on the left to I-10 West.
3. Proceed on I-10 West to Exit 781B (approximately 3.7 miles).
4. Exit freeway at Exit 781B onto East Freeway Service Road.
5. Continue heading west on East Freeway Service Road (approximately 0.2 miles). Triumph Hospital will be on the right (total distance approximately 5 miles).

Figure C

Hospital Detail (Egress from I-10 West)



1 EMERGENCY RESPONSE PROCEDURES

In the event of an emergency, refer to the procedures in the San Jacinto River Waste Pits Superfund Site Overall HASP (Anchor QEA 2009).

A copy of this Addendum must be included with the overall HASP, and both copies must be available in the field at all times during field work. Additions to Section 2 detailing the area-specific scope of work are provided below.

2 SCOPE OF WORK

The TCRA Cap Porewater Assessment field scope has been described in detail in the Draft Sampling and Analysis Plan: TCRA Cap Porewater Assessment dated April 2012 (Integral and Anchor QEA 2012). A summary of the scope is provided below.

The TCRA Cap Porewater Assessment will be performed using passive samplers installed by manually driving rebar, or similar steel probe, into the cap materials and sliding the passive samplers into cap along the edge of the probe and removing the probe and leaving the passive sampler in place for a period of approximately 30 days. The passive samples will be retrieved by pulling the devices manually, or by simple mechanical means. Sample locations will likely be inundated, requiring access by water vessels and divers. The sampling design includes installation of 20 passive samplers (including replicates).

Boating/diving services will be subcontracted and that subcontractor will be required to prepare its own health and safety procedures for the work tasks they are performing. For informational purposes, task specific Job Safety Analyses (JSAs) from the selected subcontractor are included in Attachment A. Note these JSAs will be part of the subcontractor overall HASP.

ATTACHMENT A

Benchmark Ecological Services, Inc.

Job Safety Analysis 001

Boat/Barge and SCUBA Diving Activities

JSA001

Project Name: San Jacinto River Waste Pits	**Project Number:** 090557-01	**JSA Number:** 001	**Issue Date:** TBD
Location: San Jacinto River, Harris County, Texas	**Contractor:** Benchmark Ecological Services, Inc.	**Analysis by:** Scott Kemmerer	**Date:** February 7, 2012
Work Operation: Boat/Barge and SCUBA Diving Activities	**Competent Person:** Scott Kemmerer	**Revised by:**	**Revised Date:**
Required Personal Protective Equipment: • U.S. Coast Guard approved personal floatation device (PFD) • SCUBA gear		**Reviewed by:**	**Date:**
		Approved by:	**Date:**

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Boat/Barge Activities	Marine Operation Hazards	• Equip all vessels in accordance with U.S. Coast Guard regulations.	• Review boating safety checklist daily.
Navigation	Boat Traffic	• Maintain a safe operating distance from shoreline, other vessels, etc.	
Boat Operations	Accidents	• Always operate the vessel in a safe manner, and operate the boat with care in shallow-water areas. • Avoid areas with heavy debris or vegetation while traveling between work locations. • Only experienced personnel are to launch, operate, and dock the boat.	
	Capsize Boat	• Keep weight evenly distributed in boat. • Be aware of waves, surges, and currents.	

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Major Emergency / Abandon Ship	• Be prepared to abandon ship in the event of a major emergency or fire that is too large to control with fire extinguisher. • Only the captain can order personnel to abandon the vessel. • Communicate the intent to abandon ship to all personnel on board. • Call 911. • Notify Project Manager and CHSO, if time permits. • Notify nearby vessels of intent to abandon ship. • Be aware of the propeller before abandoning ship. • Identify a rally point for all personnel. • Use the buddy system to support injured personnel.	• Abandon ship drills should be done on an annual basis and reviewed prior to each job. • Inspect all fire extinguishers on the vessel.
Loading/Unloading Equipment onto Vessel	General	• Secure boat prior to loading/unloading activities. • Use railing or have assistance with loading large or heavy items. • Avoid directly carrying any equipment while entering or exiting the vessel. Load the items off the pier or hand them to someone who has already boarded the vessel. • Never overload the vessel. • Distribute weight evenly on the boat. • Be cautious when entering/exiting the vessel. With one hand on the boat, quickly lower straight down onto the center of the vessel. Never jump on or off of a vessel.	
	Slips, Trips, Falls	• Be aware of slippery surfaces and tripping hazards. • Wear footwear that has sufficient traction to reduce the risks associated with slipping. • Keep all walkways clear of equipment and debris to deter any trips and falls. • Clean up all spills immediately. • Notify the captain and safety officer of any unsafe conditions. • Always walk slowly while on the vessel. No running, jumping or horseplay while on the vessel.	

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Fall From Boat / Drowning Hazard	• Wear footwear that has sufficient traction to reduce the risks associated with slipping. • Wear personal flotation devices while on the boat and dock. • Be aware of any obstacles which may cause a slip, trip or fall from the vessel.	• Inspect PFDs daily prior to use.
	Man Overboard	• Yell "Man Overboard". • Have one person maintain visual contact with the individual overboard at all times. • If the engine is running, take it out of gear and swing the stern clear to avoid hitting the person in the water. • Call 911, as appropriate. • If needed, contact nearby vessels for assistance. • Throw floatation devices immediately towards the person overboard. • Recover person from water as soon as possible. • If you fall overboard, once you reach the surface, look for movement, listen for sounds and call for help. If available, use the whistle attached to your PFD, and activate the beacon light. • If immediate rescue is not available, and it is sensible, swim to a destination only if there is reason to believe that the destination can be reached safely.	• Perform Man Overboard drills annually. Review actions prior to each job.
	Muscle Strain/Injury From Improper Lifting	• Utilize proper lifting techniques. • If an object is too heavy or large to lift, ask for assistance.	
	Rain	• Have appropriate rain gear on the vessel. • Be aware of slips, puddles and electrical hazards when working near water.	

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Lightning	• Do not work on or over water during a thunderstorm. Immediately stop all work and head to shore if lightning is observed. • Have adequate shelter available during a thunderstorm. • Do not begin or resume work until 20 minutes after the last time lightning was observed. • If adequate shelter is unavailable, crouch on ground during storm.	
	Fog	• Wait for fog to lift and adequate visibility prior to operating any vessel.	• Inspect vessel lights.
	Heat Stress	• Adjust work schedules, as necessary. • Perform any physically demanding work during cooler hours of the day. • Provide shelter (air conditioned or shaded) to protect personnel during rest periods. • Keep plenty of fluids onsite. Ensure all personnel are hydrated. • Train personnel to recognize the signs and symptoms of heat related illnesses.	• Monitor personnel physical conditions. • Monitor outside temperature versus worker activity.
	Sunshine/UV Exposure	• Have sunscreen available for sunburn protection. Apply as needed to prevent sunburns. Apply sunscreen on overcast days as well. Sunburns will occur during cloudy conditions. • Use sunglasses to reduce direct sunlight to eyes. • Drink plenty of fluids to prevent dehydration.	• Routinely inspect for sunburn.

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
SCUBA Diving	General	• Only certified and qualified personnel are to perform diving operations. • While diving operations are in progress, the lead diver will control all aspects of the vessel operation. • The engine of the vessel will be stopped, taken out of gear and not started while divers are in the water unless an emergency arises which requires immediate action. • A SCUBA flag or alpha flag will be visible 360 degrees from the vessel while diving operations are in progress. • All divers will file a dive plan and make a dive table profile to determine the decompression limits of the dive. • All divers will inspect dive gear prior to use. Any gear showing signs of damage or malfunction shall not be used during diving operations. • Divers will leave a minimum of 500 psi in each tank prior to surfacing.	• Ensure all diving personnel have completed and have been issued a certification card by a recognized diving institution. • All divers will inspect their dive gear prior to each dive to be performed.
	Compressed Air Tanks	• Ensure all air tanks are secured and tied off prior to travel. • Visually inspect all tanks for any signs of neglect, rust or other visual defects. • Only compressed air tanks designed for diving operations shall be used.	• Ensure all compressed air tanks are hydrostatically and visually inspected prior to use.
	Hypothermia	• All divers will wear wetsuits, booties and hoodies (if necessary) designed for diving operations. • If diving in cold water (<59 degrees), a dry suit shall be utilized.	• Inspect all wetsuits for damage.

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Water Entry and Exit	• Enter water in a controlled fashion. If unsure of bottom conditions, do not jump into water. Slide into water from edge of boat. • Inflate buoyancy control device prior to water entry. • Hold all gear tightly to body while entering water to prevent loss of gear. • Upon entry to the water, the diver shall give an ok hand signal to tell vessel members that he is alright and prepared to perform the dive. • If no ladder is present for exiting the water, the diver shall remove their buoyancy control device and tank to pass the equipment to personnel on the vessel. The diver will then exit the water.	
	Decompression Sickness	• All divers will file a dive plan and perform a dive table to determine the limits of no decompression and follow the dive tables as established by the institution from which the diver was certified. • All dives shall be no decompression dives unless the dive profile and tables have been approved through the diving safety officer. • All divers suspected to be suffering from decompression sickness shall be taken to the nearest medical facility for treatment.	
Installing Porewater Probes	Pinch Points	• Ensure all hands are clear before placing porewater probes. • Wear latex or rubber coated work gloves while diving to prevent potential hand injury.	

Training Requirements:

All personnel working on hazardous waste sites must receive appropriate training as required by 29 CFR 1910.120(e), including, but not limited to, initial 40-hour and annual 8-hour refresher training. All boat operators must have successfully completed the Texas Safe Boating Course. All divers must have received a certification in open water diver at a minimum by an approved diving institution.

All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity, and review it with their Supervisor during Daily Safety Meetings.

Benchmark Ecological Services, Inc.

Job Safety Analysis 002

Installing Rebar at Porewater Probe Locations

JSA002

Project Name: San Jacinto River Waste Pits	**Project Number:** 090557-01	**JSA Number:** 002	**Issue Date:** TBD
Location: San Jacinto River, Harris County, Texas	**Contractor:** Benchmark Ecological Services, Inc.	**Analysis by:** Scott Kemmerer	**Date:** February 7, 2012
Work Operation: Installing rebar at porewater probe locations	**Competent Person:** Scott Kemmerer	**Revised by:**	**Revised Date:**
Required Personal Protective Equipment: • Modified Level D – Steel toes, safety glasses, non-slip steel toe footwear, leather gloves. • U.S. Coast Guard approved personal floatation device (PFD) if working over or near water edge.		**Reviewed by:**	**Date:**
		Approved by:	**Date:**

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Traversing Rip-Rap on Cap	Slips, Trips, and Falls	• Wear supportive non-slip footwear while working on the rip-rap. • Ensure foot placement of each step. Do not walk on loose or shifting rocks. • Watch for algae accumulation which makes walking surfaces slippery. • Do not carry more items than needed to complete the work. If necessary, make multiple trips between work locations and staging areas to ensure good footing. • No running, jumping or horseplay while traversing the rip-rap.	
	Pinch Points from Shifting Rocks	• Ensure foot placement of each step.	
Installing Rebar for Porewater Locations	Pinch Points	• Do not stick hands between rocks.	
	Hand Strike Hazards	• Ensure area is clear before placing and hammering rebar into position. • Wear leather gloves to prevent metal splinters from entering hand.	
	Muscle Strain/Injury From Improper Lifting	• Utilize proper lifting techniques. • If an object is too heavy or large to lift, ask for assistance.	

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
	Rain	• Have appropriate rain gear available. • Be aware of slips, puddles, and electrical hazards when working near water.	
	Lightning	• Do not work on or over water during a thunderstorm. Immediately stop all work and head to shore if lightning is observed. • Have adequate shelter available during a thunderstorm. • Do not begin or resume work until 20 minutes after the last time lightning was observed. • If adequate shelter is unavailable, crouch on ground during storm.	
	Heat Stress	• Adjust work schedules, as necessary. • Perform any physically demanding work during cooler hours of the day. •Provide shelter (air conditioned or shaded) to protect personnel during rest periods. • Keep plenty of fluids onsite. Ensure all personnel are hydrated. • Train personnel to recognize the signs and symptoms of heat related illnesses.	• Monitor personnel physical conditions. • Monitor outside temperature versus worker activity.
	Sunshine/UV Exposure	• Have sunscreen available for sunburn protection. Apply as needed to prevent sunburns. Apply sunscreen on overcast days as well. Sunburns will occur on cloudy conditions. • Use sunglasses to reduce direct sunlight to eyes. • Drink plenty of fluids to prevent dehydration.	• Routinely inspect for sunburn.

Training Requirements:

All personnel working on hazardous waste sites must receive appropriate training as required by 29 CFR 1910.120(e), including, but not limited to, initial 40-hour and annual 8-hour refresher training. All boat operators must have successfully completed the Texas Safe Boating Course.

All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their Supervisor during Daily Safety Meetings.

ATTACHMENT A2
STANDARD OPERATING PROCEDURES

LIST OF STANDARD OPERATING PROCEDURES

SOP AP-01 Sample Packaging and Shipping

SOP AP-02 Field Documentation

SOP AP-03 Sample Custody

SOP AP-04 Sample Labeling

SOP AP-06 Navigation and Station Positioning

SPME Method

STANDARD OPERATING PROCEDURE (SOP) AP-01

SAMPLE PACKAGING AND SHIPPING

SCOPE AND APPLICATION

This SOP describes specific requirements for sample packaging and shipping to ensure the proper transfer and documentation of environmental samples collected during field operations. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein. This SOP also presents the method to be used when packing samples that will either be hand delivered or shipped by commercial carrier to the laboratory.

EQUIPMENT AND SUPPLIES REQUIRED

Make sure that you have the equipment and supplies necessary to properly pack and ship environmental samples, including the following:

- Project-specific sampling and analysis plan (SAP)
- Project-specific field logbook
- Sealable airtight bags in assorted sizes (e.g., Ziploc®)
- Wet ice in doubled, sealed bags; frozen Blue Ice®; or dry ice
- Cooler(s)
- Bubble wrap
- Fiber-reinforced packing tape, clear plastic packing tape, and duct tape
- Scissors or knife
- Chain-of-custody (COC) forms
- COC seals
- Large plastic garbage bags (preferably 3 mil [0.003 in.] thick)
- Paper towels
- "Fragile," "This End Up," or "Handle With Care" labels
- Mailing labels
- Air bills for overnight shipment

PROCEDURE

Customize the logistics for sample packaging and shipping to each study. If necessary, transfer samples from the field to a local storage facility where they can be frozen or refrigerated. Depending on the logistics of the operation, field personnel may transport samples to the laboratory or use a commercial courier or shipping service. In the latter case, Integral field personnel must be aware of any potentially limiting factors to timely shipping, such as availability of overnight service and weekend deliveries to specific areas, and shipping regulations regarding "restricted articles" (e.g., dry ice, formalin) prior to shipping the samples.

SAMPLE PREPARATION

Take the following steps to ensure the proper transfer of samples from the field to the laboratories:

At the sample collection site:

1. Document all samples using the proper logbooks or field forms (see SOP AP-02), required sample container identification (i.e., sample labels with tag numbers), and COC form (example provided in SOP AP-03). Fill out the COC form as described in SOP AP-03, and use the sample labeling techniques provided in SOP AP-04.
2. Make all applicable laboratory quality control sample designations on the COC forms. Clearly identify samples that will be archived for future possible analysis. Label these samples as follows: "Do Not Analyze: Hold and archive for possible future analysis." Some laboratories interpret "archive" to mean that they should continue holding the residual sample after analysis.
3. Notify the laboratory contact and the Integral project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all COC forms to Integral's project QA/QC coordinator or project manager, as appropriate.
4. Keep the samples in the possession of the sampling personnel at all times. Lock and secure any temporary onsite sample storage areas to maintain sample integrity and COC requirements.
5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.
6. Complete the COC form as described in SOP AP-03, and retain the back (pink) copy for project records prior to sealing the cooler. Check sample containers against the COC form to ensure all the samples that were collected are in the cooler.

7. Store each sample container in a sealed plastic bag that allows the sample label (example provided in SOP AP-03) to be read. Before sealing the bags, ensure that volatile organic analyte (VOA) vials are encased in a foam sleeve or in bubble wrap.
8. If the samples require storage at a specific temperature, place enough ice in the sample cooler to maintain the temperature (e.g., 4°C) throughout the sampling day.

At the sample processing area (immediately after sample collection) take the following steps:

1. If the samples require a specific storage temperature, then cool the samples and maintain the temperature prior to shipping. For example, place enough ice in each sample cooler to maintain the temperature at 4°C until processing begins at the testing laboratory.
2. Be aware of holding time requirements for project-specific analytes and arrange the sample shipping schedule accordingly.
3. Place samples in secure storage (i.e., locked room or vehicle) or keep them in the possession of Integral sampling personnel before shipment. Lock and secure any sample storage areas to maintain sample integrity and COC requirements.
4. Store samples in the dark (e.g., keep coolers shut).

At the sample processing area (just prior to shipping), do the following:

1. Check sample containers against the COC form to account for all samples intended for shipment.
2. Choose cooler(s) of appropriate size and make sure they are clean of gross contamination inside and out. If the cooler has a drain, close the drain and secure it with duct tape.
3. Line the cooler with bubble wrap and place a large plastic bag (preferably with a thickness of 3 mil), open, inside the cooler.
4. Individually wrap each glass container (which was sealed in a plastic bag at the collection site) in bubble wrap and secure with tape or a rubber band. Place the wrapped samples in the large plastic bag in the cooler, leaving room for ice to keep the samples cold (i.e., 4°C).
5. If temperature blanks have been provided by the testing laboratory, place one temperature blank in each sample cooler.
6. If the samples require a specific storage temperature, add enough wet ice or Blue Ice® to maintain that temperature during overnight shipping (i.e., 4°C). Always overestimate the amount of ice that will be required. Keep ice in a sealed plastic bag, which is placed in a second sealed plastic bag to prevent leakage. Avoid separating the samples from the ice with excess bubble wrap because it may insulate the samples from the ice. After adding all samples and ice to the cooler, use bubble wrap (or other

available clean packing material) to fill any empty space and prevent the samples from shifting during transport.

7. If possible, consolidate all VOA samples in a single cooler and ship them with (a) trip blank(s) if the project-specific QA project plan calls for them.
8. Sign, date, and include any tracking numbers provided by the shipper on the COC form. Remove the back (pink) copy of the original COC form and retain this copy for the project records.
9. Seal the rest of the signed COC form in a bag and tape the bag to the inside of the cooler lid. Each cooler should contain an individual COC form for the samples contained inside it. If time is short and it becomes necessary to combine all the samples onto a single set of COC forms and ship multiple coolers together, then indicate on the outside of the appropriate cooler, "Chain-of-Custody Inside."
10. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it with fiber-reinforced packing tape. Tape the cooler around the opening, joining the lid to the bottom, and around the circumference of the cooler at both hinges.
11. As security against unauthorized handling of the samples, apply two COC seals across the opening of the cooler lid (provided with example field forms). Place one seal on the front right portion of the cooler and one on the back left. Be sure the seals are properly affixed to the cooler to prevent removal during shipment. Additional tape across the seal may be necessary if the outside of the cooler is wet.

SAMPLE SHIPPING

Hand Delivery to the Testing Laboratory

1. Notify the laboratory contact and the Integral project QA/QC coordinator that samples will be delivered to the laboratory and the estimated arrival time.
2. When hand-delivering environmental samples, make sure the testing laboratory receives them on the same day that they were packed in the coolers.
3. Fax or scan and e-mail copies of all COC forms to the Integral project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after it has been faxed. Never leave the original COC form in the custody of non-Integral staff.

Shipped by Commercial Carrier to the Laboratory

1. Apply a mailing label to the cooler with destination and return addresses, and add other appropriate stickers, such as "This End Up," "Fragile," and "Handle With Care." If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the cooler and to protect it from the weather. This is a secondary label in case the air bill is lost during shipment.
2. Fill out the air bill and fasten it to the handle tags provided by the shipper (or the top of the cooler if handle tags are not available).
3. If samples must be frozen (–20°C) during shipping, make sure that dry ice has been placed in the sample cooler. Be aware of any additional shipping, handling, and special labeling requirements that the shipper may require.
4. Make sure that benthic infauna samples have been preserved with formalin in the field prior to shipping. Be aware of any additional shipping, handling, and special labeling requirements that the shipper may require for these samples.
5. Notify the laboratory contact and the Integral project QA/QC coordinator that samples will be shipped and the estimated arrival date and time. If environmental samples must be shipped at 4°C or –20°C, choose overnight shipping for delivery next morning. Fax or scan and e-mail copies of all COC forms to the Integral project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after faxing. Never leave the original COC form in the custody of non-Integral staff.

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STANDARD OPERATING PROCEDURE (SOP) AP-02

FIELD DOCUMENTATION

SCOPE AND APPLICATION

This SOP describes the Integral procedure for accurate record-keeping in the field for the purposes of ensuring that samples can be traced from collection to final disposition.

Document all information relevant to field operations properly to ensure that activities are accounted for in written records to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. Several types of field documents are used for this purpose and should be consistently used by field personnel. Field documentation should include only a factual description of site-related activities and observations. Field personnel should not include superfluous comments or speculation regarding the field activities or observations.

FIELD LOGBOOKS

During field sampling events, field logbooks must be used to record all daily activities. The purpose of the field logbook is to document events and record data measured in the field to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. The project manager (or designee) should issue a field logbook to the appropriate site personnel for the direction of onsite activities (e.g., reconnaissance survey team leader, sampling team leader). It is this designee's responsibility to maintain the site logbook while it is in his or her possession and return it to the project manager or turn it over to another field team.

Make entries in the field logbook as follows:

1. Document all daily field activities in indelible ink in the logbook and make no erasures. Make corrections with a single line-out deletion, followed by the author's initials and the date. The author must initial and date each page of the field logbook. The author must sign and date the last page at the end of each day, and draw a line through any blank space remaining on the page below the last entry.

2. Write the project name, dates of the field work, site name and location (city and state), and Integral job number on the cover of the field logbook. If more than one logbook is used during a single sampling event, then annotate the upper right-hand corner of the logbook (e.g., Volume 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Secure all field logbooks when not in use in the field. The following is a list of the types of information that is appropriate for entry in the field notebook:
   - Project start date and end date
   - Date and time of entry (24-hour clock)
   - Time and duration of daily sampling activities
   - Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, rain, thunder, wave action, current, tide, vessel traffic, air and water temperature, thickness of ice if present)
   - Name and affiliation of person making entries and other field personnel and their duties, including what times they are present
   - The location and description of the work area, including sketches, map references, and photograph log, if appropriate
   - Level of personal protection being used
   - Onsite visitors (names and affiliations), if any, including what times they are present
   - The name, agency, and telephone number of any field contacts
   - Notation of the coordinate system used to determine the station location
   - The sample identifier and analysis code for each sample to be submitted for laboratory analysis, if not included on separate field data sheets
   - All field measurements made (or reference to specific field data sheets used for this purpose), including the time of collection and the date of calibration, if appropriate
   - The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates, if not included on separate field data sheets
   - For aquatic sampling, the type of vessel used (e.g., size, power, type of engine)
   - Specific information on each type of sampling activity
   - The sample type (e.g., groundwater, soil, surface sediment), sample number, sample tag number, and any preservatives used, if not included on separate field data sheets
   - Sample storage methods

- Cross-references of numbers for duplicate samples
- A description of the sample (source and appearance, such as soil or sediment type, color, texture, consistency, presence of biota or debris, presence of oily sheen, changes in sample characteristics with depth, presence/location/thickness of the redox potential discontinuity [RPD] layer, and odor) and penetration depth, if not included on separate field data sheets
- Estimate of length and appearance of recovered cores, if not included on separate field data sheets
- Photographs (uniquely identified) taken at the sampling location, if any
- Details of the work performed
- Variations, if any, from the project-specific sampling and analysis plan (SAP) or standard operating protocols and reasons for deviation
- Details pertaining to unusual events that might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity, control of vertical descent of the sampling equipment)
- References to other logbooks or field forms used to record information (e.g., field data sheets, health and safety log)
- Any field results not appearing on the field data sheets (if used), including station identification and location, date, and time of measurement
- Sample shipment information (e.g., shipping manifests, chain-of-custody (COC) form numbers, carrier, air bill numbers, time addresses)
- A record of quantity of investigation-derived wastes (if any) and storage and handling procedures.

3. During the field day, as listed above, record in the logbook a summary of all site activities. Provide a date and time for each entry. The information need not duplicate anything recorded in other field logbooks or field forms (e.g., site health and safety officer's logbook, calibration logbook, field data sheets), but should summarize the contents of the other logbooks and refer to the pages in these logbooks for detailed information.
4. If measurements are made at any location, record the measurements and equipment used, or refer to the logbook and page number(s) or field forms on which they are recorded. All maintenance and calibration records for equipment should be traceable through field records to the person using the instrument and to the specific piece of instrumentation itself.

5. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., groundwater monitoring form, sediment core profile form, water quality measurement form) to record the relevant sample information collected. For instructions regarding the proper identification of field data forms, sampling personnel should consult the project-specific SAP.

Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

PHOTOGRAPHS

In certain cases, photographs (print or digital) of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Ensure that photographs include a measured scale in the image, when practical. If you take photographs of sample characteristics and routine sampling activities, avoid using telephoto or wide-angle shots, because they cannot be used in enforcement proceedings. Record the following items in the field logbook for each photograph taken:

1. The photographer's name or initials, the date, the time of the photograph, and the general direction faced (orientation)
2. A brief description of the subject and the field work shown in the picture
3. For print photographs, the sequential number of the photograph and the roll number on which it is contained
4. For digital photographs, the sequential number of the photograph, the file name, the file location, and back-up disk number (if applicable).

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all photographic materials to be developed (prints) or copied (disks). Place the prints or disks and associated negatives in the project files (at the Integral project manager's location). Make photocopies of photo logs and any supporting documentation from the field logbooks, and place them in the project files with the prints or disks.

EQUIPMENT CALIBRATION RECORDS

Record in the field logbook all equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration. Calibrate all equipment used during the investigation daily, at a minimum, in accordance with the manufacturers' recommendations.

DISTRIBUTION OF COPIES

When the field team has returned from the sampling event, the field team leader is responsible for making sure that the field documentation is 1) scanned and placed into the project file on the portal (in a subfolder named Field under Working_Files), and 2) a copy of all field logbooks and additional field data forms is made and placed into the project file. Both the scanned copy and the hard copy will be available for general staff use.

The original field logbooks and forms will be placed in a locked file cabinet for safekeeping. One file cabinet at each Integral office will contain the original field documentation for multiple projects. The original field documentation will be filed at the Integral office where the project manager is located.

SET-UP OF LOCKING FILE CABINET

Place each project in its own file folder in a locking file cabinet. On the folder label, include the project name and contract number. Each project folder will include up to six kinds of files:

- Field logbook(s)
- Additional field data forms
- Photographs
- COC forms
- Acknowledgment of Sample Receipt forms
- Archive Record form (to be completed only if samples are archived at an Integral field storage facility or Integral laboratory).

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STANDARD OPERATING PROCEDURE (SOP) AP-03

SAMPLE CUSTODY

SCOPE AND APPLICATION

This SOP describes Integral procedures for custody management of environmental samples.

A stringent, established program of sample chain-of-custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with SOP AP-01, which covers sample packaging and shipping; SOP AP-02, which covers the use of field logbooks and other types of field documentation; and SOP AP-04, which covers sample labeling. Chain-of-custody (COC) forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in his or her possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

At no time is it acceptable for samples to be outside of Integral personnel's custody unless the samples have been transferred to a secure area (i.e., locked up). If the samples cannot be placed in a secure area, then an Integral field team member must physically remain with the samples (e.g., at lunch time one team member must remain with the samples).

CHAIN-OF-CUSTODY FORMS

The COC form is critical because it documents sample possession from the time of collection through final disposition. The form also provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped.

Complete the COC form after each field collection activity and before shipping the samples to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. The individuals relinquishing and receiving the samples must sign the

COC form(s), indicating the time and date of the transfer, when transferring possession of the samples.

A COC form consists of three-part carbonless paper with white, yellow, and pink copies. The sampling team leader keeps the pink copy. The white and yellow sheets are placed in a sealed plastic bag and secured inside the top of each transfer container (e.g., cooler). Field staff retain the pink sheet for filing at the Integral project manager's location. Each COC form has a unique four-digit number. This number and the samples on the form must be recorded in the field logbook. Integral also uses computer-generated COC forms. If computer-generated forms are used, then the forms must be printed in triplicate and all three sheets signed so that two sheets can accompany the shipment to the laboratory and one sheet can be retained on file. Alternatively, if sufficient time is available, the computer-generated forms will be printed on three-part carbonless paper.

Record on the COC form the project-assigned sample number and the unique tag number at the bottom of each sample label. The COC form also identifies the sample collection date and time, type of sample, project name, and sampling personnel. In addition, the COC form provides information on the preservative or other sample pretreatment applied in the field and the analyses to be conducted by referencing a list of specific analyses or the statement of work for the laboratory. The COC form is sent to the laboratory along with the sample(s).

PROCEDURES

Use the following guidelines to ensure the integrity of the samples:

1. Sign and date each COC form. Have the person who relinquishes custody of the samples also sign this form.
2. At the end of each sampling day and prior to shipping or storage, make COC entries for all samples. Check the information on the labels and tags against field logbook entries.
3. Do not sign the COC form until the team leader has checked the information for inaccuracies. Make corrections by drawing a single line through any incorrect entry, and then initial and date it. Make revised entries in the space below the entries. After making corrections, mark out any blank lines remaining on the COC form, using single lines that are initialed and dated. This procedure will prevent any unauthorized additions.

   At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date of the transfer. The time the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as FedEx or United Parcel Service (UPS), record the name of the carrier on the COC form. Also enter on the COC form any tracking numbers supplied by the carrier. The time of transfer should be as close to the actual drop-off time as possible. After signing the COC forms and removing the pink copy, seal them inside the transfer container.
5. If errors are found after the shipment has left the custody of sampling personnel, make a corrected version of the forms and send it to all relevant parties. Fix minor errors by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.
6. Provide a COC form and an Archive Record form for any samples that are archived internally at Integral.

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all COC forms to be copied. A discussion of copy distribution is provided in SOP AP-02.

CUSTODY SEAL

As security against unauthorized handling of the samples during shipping, affix two custody seals to each sample cooler. Place the custody seals across the opening of the cooler (front right and back left) prior to shipping. Be sure the seals are properly affixed to the cooler so they cannot be removed during shipping. Additional tape across the seal may be prudent.

SHIPPING AIR BILLS

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., FedEx, UPS), the shipper provides an air bill or receipt. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting the sender's copy of all shipping air bills to be copied at an Integral office. A discussion of copy distribution is provided in SOP AP-02. Note the air bill number (or tracking number) on the applicable COC forms or, alternatively, note the applicable COC form number on the air bill to enable the tracking of samples if a cooler becomes lost.

ACKNOWLEDGMENT OF SAMPLE RECEIPT FORMS

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is faxed to the project QA/QC coordinator the day the samples are received by the laboratory. The person receiving this form is responsible for reviewing it, making sure that the laboratory has received all the samples that were sent, and verifying that the correct analyses were requested. If an error is found, call the laboratory immediately, and document

any decisions made during the telephone conversation, in writing, on the Acknowledgment of Sample Receipt form. In addition, correct the COC form and fax the corrected version to the laboratory.

Submit the Acknowledgment of Sample Receipt form (and any modified COC forms) to be copied. A discussion of copy distribution is provided in SOP AP-02.

ARCHIVE RECORD FORMS

On the rare occasion that samples are archived at an Integral office, it is the responsibility of the project manager to complete an Archive Record form. This form is to be accompanied by a copy of the COC form for the samples, and will be placed in a locked file cabinet. The original COC form remains with the samples in a sealed Ziploc® bag.

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STANDARD OPERATING PROCEDURE (SOP) AP-04

SAMPLE LABELING

SCOPE AND APPLICATION

This SOP describes the general Integral procedures for labeling samples, and the three kinds of labels that can be used on a project (i.e., sample labels, sample tags, and internal sample labels). Consult the project-specific sampling and analysis plan (SAP) to determine the exact sample identifiers and sample labels that are required for a given project. If they are not specified in the SAP, then follow the designations below.

SAMPLE IDENTIFIERS

Before field sampling begins, establish sample identifiers to be assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., replicates) to ensure proper data analysis and interpretation, 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples, and 3) to track individual sample containers to ensure that the laboratory receives all material associated with a single sample. To accomplish these purposes, each container may have three different codes associated with it: the sample identifier, the sample number, and the sample tag number. These codes and their use are described as follows:

- **Sample Identification Code**—The sample identification code (Sample ID) is a unique designation that identifies where and how the sample was collected. The sample identifier is recorded in the field logbook *only* and is not provided on the sample label or chain-of-custody (COC) form. The sample identifier is a multiple-part code. The first component begins with the letter abbreviation; for example, "SWNS" or "SWNB" to designate the surface water sample was collected from the near-surface or near-bottom of the water column. The second part could identify the sampling event; for example, "1" to designate Round 1 sampling. The third part could contain an abbreviation for whether the station is a single point (SP), a transect (TR), a composite (CO), or a vertically integrated station (VI). The station number would be the final component of the sample identifier. Use leading zeros for stations with numbers below 100 for ease of data management and correct data sorting.

  If appropriate, add a supplemental component to the sample identifier to code field

duplicate samples and splits. Use a single letter (i.e., a suffix of "A" and "B") to indicate field duplicates or splits in the final component of the sample identifiers. For equipment decontamination blanks, assign sequential numbers starting at 900 instead of station numbers. Use a sample type code that corresponds to the sample type for which the decontamination blank was collected. Additional codes may be adopted, if necessary, to reflect sampling equipment requirements (see project-specific SAP).

Examples of sample IDs are as follows:

- SWNS-1-SP-002: Surface water sample collected from the near-surface at a single point during Round 1 from Station 2.
- SWNB-1-TR-010-A: Duplicate surface water sample from the near-bottom transect during Round 1 from Station 10.

- **Sample Number**—The sample number is an arbitrary number assigned to each distinct sample or split that is shipped to the laboratory for separate analysis. The sample number appears on the sample containers and the COC forms. Each sample will be assigned a unique sample number. All aliquots of a composited field sample will have the same sample number. In cases where samples consist of multiple bottles from the same location, assign each bottle the same sample number and time. However, assign replicates from the same location different sample numbers and times. Sample numbers of related field replicates will not necessarily have any shared content.

  Each field split of a single sample will also have a different sample number and time. The sample number is generally a unique six-digit number that includes a two-digit media code and a four-digit number. The media code may be site-specific, but the Integral default codes are as follows:

  - SS—Surface soil
  - BH—Subsurface soil or rock (typically from borehole)
  - GW—Groundwater
  - SW—Surface water
  - PW—Pore water
  - SD—Sediment
  - BT—Biota or biological tissue

  The exact sample numbering scheme may vary from project to project. Variances in the sample numbering scheme will be described in the project-specific SAP for the field event. Example sample numbers are PW0001, PW0002, PW0003, etc.

- **Tag Number**—Attach a different tag number to each sample container. If the amount of material (i.e., everything associated with a single sample number) is too large for a single container, assign each container the same sample number and a different sample tag. A sample will also be split between containers if a different preservation technique is used for each container (i.e., because different analyses will be conducted).

  The sample tag number is a unique five- or six-digit number assigned to each sample label (or "tag") for multiple bottles per sample. Integral sample labels come with a preprinted sample tag number. The tag number provides a unique tracking number to a specific sample bottle. This allows for greater flexibility in tracking sample bottles and assists in field quality control when filling out documentation and shipping. Sample tags are not used by many other consultants, and there may be resistance from such firms during teaming situations. However, experience has shown that tags can be very valuable, both in the field and while processing data from field efforts.

  Record tag numbers on the COC form. Laboratories use tag numbers only to confirm that they have received all of the containers that were filled and shipped. Data are reported by sample number.

Assign sample numbers sequentially in the field; sample labels are preprinted with sequential tag numbers.

SAMPLE LABELS

Integral sample labels are designed to uniquely identify each individual sample container that is collected during a sampling event. Field sampling teams are provided with preprinted sample labels, which must be affixed to each sample container used. Fill out the labels at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- A unique number (commonly referred to as the "Tag Number") that is preprinted on the label consisting of five or six digits; used to identify individual containers.

SAMPLE TAGS

Integral sample tags are designed to be affixed to each container that is used for a sample. Sample tags are required only for environmental samples collected in certain U.S.

4. Screw antenna to the attachments on the top of the backpack. Wind cord around pole, and ensure the antenna is secure. Please be aware of overhead hazards, especially if working near low-hanging power lines. Severe injury or death can result.

Basic Operation of the Pro XRS

Recording a Feature

Before beginning field use, ensure that all GPS configurations and settings are set correctly for the particular use of the Pro XRS and that an appropriate data dictionary is loaded onto the TSC1 (see Attachments 2 and 3 for typical settings). These steps outline the basic use of the GPS to document a sample position or any other defined "feature." Note that the TSC1 has both hard and soft keys that allow for its operation. The hard keys comprise all of the keys (e.g., letters and numbers) on its surface. The soft keys are the F1 through F5 hard keys. The function of these changes depending upon the context. These keys will be referred to with brackets around them (<soft-key>).

1. Turn data logger on outside in an open area. Wait for antenna to receive satellite signals. The display will read Recording Almanac, Too Few SVs, and PDOP Too High. Continue to wait until enough satellites (four) are acquired and the PDOP is below 5.0.
2. Ensure that the real-time settings are correct according to the parameters listed in Attachment 2.
3. Select **Data Collection**, and create a new rover file or open an existing file. This file should be named according to the format specified by the project GIS analyst. Note: If opening an existing file, press **<NEW>** to access the *Antenna Options* menu and *Start Feature* menu.
4. Enter the height of the antenna from the ground to the *Measurement Method* reference point shown in the *Antenna Options* menu and then press **ENTER** to bring up the *Start Feature* menu.
5. Pick the appropriate data dictionary to use with the rover file. Only one dictionary can be used with a rover file. Consult with the project GIS analyst to formulate the most appropriate data dictionary for the type of sampling you wish to perform. The data dictionary titled *Generic* contains only a comment field and is appropriate for simple navigation tasks. If using a data dictionary, make sure to become familiar with its attributes before recording information in the field.

6. Move to the location of the first feature for which you want to record the GPS position. Select the appropriate feature and press **ENTER** to begin logging. Log data points in accordance with the feature type. Point features should have at least 10 points collected at a stationary location. Line features should be collected while moving. If movement is stopped, press the **<PAUSE>** key. When movement starts again, press the **<RESUME>** key. Area features should be collected with enough points to define the outline of the area (e.g., a square building would have four single points, collected on each corner, and the **<PAUSE>** key would be used between each of the points).
7. Depending on the setup of the data dictionary, each feature may have one or more feature attributes. An attribute is used to record additional data associated with the feature. For example, the attributes assigned to a sediment sampling station could be the sample number, station ID, sampling gear, sediment color, odor, etc.
8. Use the **<PAUSE>** key while recording feature attributes to avoid too many data points being collected at one point feature. (Body movements while logging attributes for an extended time can decrease the accuracy of collection.) The **<PAUSE>** key must be used when recording attributes of a line or area feature because only one data point should be collected in a single location.
9. Once all attributes are entered and the feature data points are logged, press **ENTER** to complete and save the feature and move on to a new feature. Pressing **ESC** instead of **ENTER** will allow the user to abandon the logged feature without saving.
10. When all features in a given area have been recorded, from the *Data Collection* menu, press **ESC** to exit data capture and then press **<YES>** to close the file. Features are appended and saved to the file after each collection, so there is no need to "save" the file. When the Pro XRS is not in use, it should be turned off. If you need to come back to the same rover file later in the day, the rover file may be reopened at that time. Rover files may not be edited after 7 days from the first feature was created. Please consult the project GIS analyst for the best way to handle multi-week sampling projects.
11. At the end of each day, download the rover file to a PC using Pathfinder Office software.

Feature Collection Options

Offsets—The Pro XRS can collect a point or line feature while standing at a set distance away from the feature. This option may be necessary because of obstructions such as tree cover, buildings, or car traffic. For a point feature, measure the distance between the object you want recorded and the Pro XRS antenna. Use the compass to determine the bearing (e.g., west is 270°). The bearing is the direction the point should be moved for it to be located in the correct place (e.g., if you are due north of the feature, the bearing is south, or 180°; i.e., the position you want recorded is south of where you are standing). Estimate the inclination from the

feature to the GPS antenna (if altitude determination is critical, a clinometer should be used). The inclination is the degree angle up from the feature to the antenna (e.g., if the feature is 5° below the antenna position, enter -5°). During data capture, from within the feature, press the **<OFFSET>** button, and enter the distance, bearing, and inclination. Press **OK** to complete the feature. Note: This procedure describes an offset of a single feature. A constant offset may be applied to all features collected as well.

Nesting—While recording a line feature or an area feature, a point feature may be collected to avoid backtracking. While recording the line or area feature, press **<PAUSE>** and then **<NEST>**. The Pro XRS will prompt for collection of a new feature. Move to the feature, and collect data as for any other point feature. When the feature is complete, press **OK**. The Pro XRS is ready to resume collecting data as part of the line/area feature: press **<RESUME>**. (Remember to continue moving before pressing resume to avoid having multiple positions recorded in the same place in the line or area feature.)

Segmenting—While moving along a line feature, changing the attributes of that line may be necessary (e.g., because of a change in surface type from paved to dirt road). This change may be done without having to begin a new feature by pressing **<PAUSE>** and then ****. Change the appropriate attributes and then press **<RESUME>** to continue recording.

Repeat—This function allows the collection of a new feature with the same feature attributes as the previous feature. If features are not exactly the same, it also allows editing of the attributes.

Quickmark—Allows collection of point features while moving (e.g., from a car or a boat) by estimating the exact location. The use of this feature will not result in positionally accurate locations and is not recommended for most sampling operations.

Reviewing and Editing Features

It is possible to review or edit features collected in the field while still in the data capture mode. For example, it may be necessary to document the GPS location in the field logbook or to edit one of the feature's attributes. Without exiting data capture, press **<REVIEW>**. (If data capture is already complete, just press **<REVIEW>** and then select the appropriate rover file.) This step will display a list of data points including each feature collected. Scroll to the appropriate feature, and follow the steps below depending on the required action:

- To view the GPS location (e.g., lat/lon), press **<POS>**.
- To edit the attributes, press **ENTER**. Make any necessary edits to the attributes by scrolling through.
- To change or add an offset, press **<POS>** and then **<OFFSET>**. Make any necessary changes.
- To delete a feature collected in error, press **<DEL>**.

Navigating to an Existing Location

Waypoints

To use the Pro XRS to navigate to a previously established position, this position must be loaded into the data logger as a waypoint, present as a feature position in the data files, or generated in the field using the GPS unit. Waypoints may be entered into the TSC1 by:

- Entering coordinates manually
- Choosing previously recorded locations and importing them into the TSC1 by using Pathfinder Office
- Defining a location stored in a rover file saved to the TSC1 as a waypoint (see *Reviewing/Editing Features*, above)
- Creating a way point from the current position being shown by the operating GPS unit in the field.

Navigating

Usually you will use the *Navigation* module (accessed by pressing **MENU** followed by **Navigation**) to guide yourself to a target (waypoint or feature). You can also use the *Map* module (accessed by pressing **MENU** followed by **Map**) to:

1. Orient yourself in the area where you are working.
2. Get a general indication of the location of a feature or waypoint that you want to find.
3. Find or select features or waypoints to which you wish to navigate toward.
4. Plot a course from one place to another.
    a. While in the Map screen, the GPS cursor x shows the current position reported by the receiver and is always shown on the Map screen (Note: it may not always be within the visible part of the screen when panning or scrolling). The **<OPTIONS>** key can be used to hide or display the GPS trail (line of dots showing up to 60 previous positions), the heading showing the direction of travel, and other options on the map display.
    b. Select a feature by pressing **MENU**, Data Collection to reach the *Start Feature* screen, and then **<REVIEW>** to access all features contained in the data file. Highlight and select the desired feature by pressing the **<Target>** key, which adds a crossed flag to the feature. Reaccess the *Map* screen by selecting **MENU**, then **Map**, which will now show the highlighted feature with a crossed flag symbol on the Map screen. You can then start moving toward the feature, and the current position (shown by the x) will move closer to the target position as the user approaches.

c. There are two graphical modes of navigation with the Pro XRS in the TSC1 *Navigation* module. On both modes, text information appears on the right of the screen in the *Info* panels, which can be configured by the user. The graphical modes available are the *Directional Dial* screen or the *Road* screen, which can be toggled between using the **<Mode>** key.

d. To navigate, select a target and then a start position. Each of these positions can be features from an open data file or a waypoint. Access a list of available features or waypoints by pressing **<TARGET>** or **<START>**. Once the item has been chosen as a target, it will show the crossed flags symbol in the list. Once a target has been selected, *Distance to Go* appears at the bottom of the *Navigation* screen, which indicates the distance from the current GPS position to the target. Select a start position (not required but useful for calculating crosstrack error and other navigation information) by pressing **<START>**. A waypoint of the current GPS position can be created for use as the Start point by selecting **<CREATE>**. Once the Start position is selected, a flag symbol will appear next to the item in the list.

e. In the *Directional Dial* mode, an arrow will appear that will always point at the target. This is the bearing to go. (Note: You need to be moving for this to be accurate, as it will lock if you are moving too slowly or have stopped.) The triangle at the top represents the direction that you are going or heading. This triangle never moves, but by changing directions, you can line up the arrow with the triangle. When the two are aligned, you are heading in the direction of the target. When you are close to the target, a bull's-eye (two concentric circles) will appear at the edge of the screen. This is warning you that the unit will be switching to the close up screen. A proximity alarm will sound and the directional arrow will be replaced by the bull's-eye on the close up screen. Your current position will be shown by an x and the target by the bull's-eye. Move so that the x is in the same location as the bull's-eye.

f. In the *Road* mode, navigate by walking down a road. Your position is shown by a stick figure and is always positioned in the center of the screen. The target (crossed flags) shows the point to which you are navigating toward. Your heading is shown by the top center of the screen and the bearing to go is shown by the direction of the road, which will rotate as you change your heading. Change your heading until the road is pointing at the top of the screen (*Target* is also at the top of the screen) and the edges are parallel to the sides of the screen. As you move toward the target the screen zooms in, so the road appears to get wider.

Downloading Rover Files

Upon returning to the office, download all rover files from the TSC1 to a PC for post-processing. You will need the Trimble Pathfinder software installed on your computer. If you

are not using a field laptop that already has the program installed, contact your project GIS analyst for instructions on how to install the software.

Connect the TSC1 to your computer using the appropriate cables. In addition to the "pigtail" cable, you will also need a null modem (a 9-pin female-to-female cable) to plug into a PC serial port. Once connected, power up the TSC1 unit and navigate to *MENU>File Manager>File Transfer*. Then, open the Pathfinder software and navigate to the *Utilities>Data Transfer...* window from the menu bar. Select **GIS Datalogger** on COM1 (for most computer systems), and press the green **Connect** button. Download files from the TSC1 by selecting the **Receive** tab and choosing the data file type from the *Add* pulldown menu (Figure 1).

After downloading, remove all rover files and waypoints from the TSC1 to conserve memory. Rover files may be deleted from the *File Manager* menu as follows:

1. Select **MENU>File Manager>Delete File(s)**
2. Select the rover file to be deleted, and press **<ENTER>**
3. Confirm the deletion of this file by pressing **<YES>**.

Delete data dictionaries in the same manner by selecting **Data Dictionaries** from the *File Manager* menu. Delete waypoints by selecting **Utilities** from the *Main* menu and then by selecting **Waypoints,** followed by **<DEL>**.

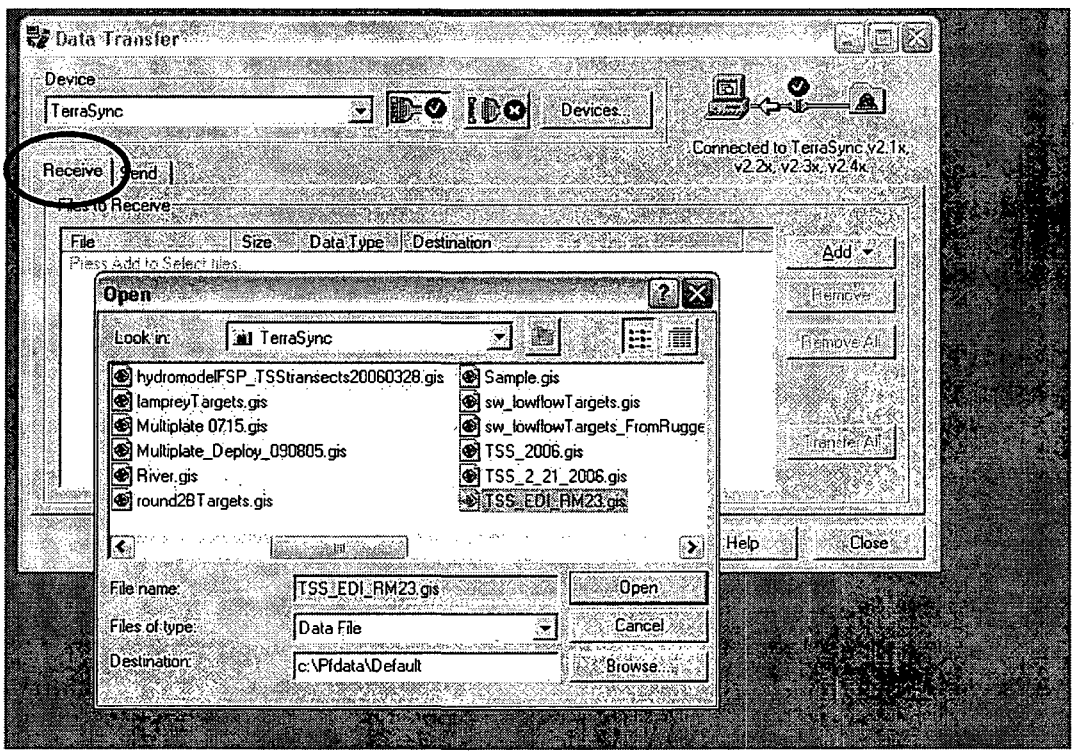


Figure 1. Transferring File from Terrasync

ATTACHMENT 2
TSC1 SETTINGS

The following are lists of menus that can be accessed through the TSC1 keypad. Please ensure that settings are correct before proceeding. Do not make changes to the settings unless necessary. Each menu will list all available subheadings, the correct setting, and the available **<soft-keys>** to access additional menus. Comments are included only where necessary.

GPS Rover Options

To access this menu, select **Configuration** from the main menu and then select **GPS Rover Options**. The table below lists logging options and settings.

Logging Options	Setting	Comment
Logging intervals		
Point feature	1s	
Line/area feature	2s–5s	depending upon speed of movement
Not in feature	None	
Velocity	None	
Confirm end feature	No	
Minimum pos	10	
Carrier Mode	Off	
Carrier phase min. time	10 minutes	
Dynamics code	Land	May be changed to sea or air, as appropriate
Audible click	Yes	
Log DOP data	Yes	
Log PPRT data	Yes	
Log QA/QC data	Yes	
Allow GPS update	Warn First	
Warning Distance	Any	
Position Mode Manual	3D	
Elevation Mask	15°	Should not go below 13° (accuracy decreases)
SNR Mask	6.0	Can raise to 7 if multi-path filtering is poor
PDOP Mask	5.0	Can be raised up to 8; reduces accuracy
PDOP Switch	6.0	

Real-Time Input Options

Access this menu from the GPS Rover *Options* menu by selecting **Real-Time Input**. The table below shows options and settings for real-time input.

Options	Setting	Comment
Preferred Correction Source		
	Choice 1	Integrated Beacon
	Choice 2	Integrated WAAS
	Choice 3	Use uncorrected GPS
Correction Age Limit	20s	

Antenna Options

Access this menu from the GPS rover *Options* menu by selecting **Antenna Options.** The table below shows antenna options and settings.

Option	Setting	Comment
Height	6 ft	Enter correct user antenna height using measurement method indicated below
Measure	Uncorrected	
Type	Integrated GPS/Beacon/Satellite	
Confirm	Per file	Can be changed to "Per feature" if antenna height varies and elevation is critical
Part Number	33580-50	Auto selected based on TYPE selected
Measurement	Bottom of Antenna	
Method	Mount	

ATTACHMENT 3
ADDITIONAL SETTINGS FOR THE TSC1

Additional TSC1 settings can be found in the *Configuration* menu. Items of particular importance are indicated in italics.

Configuration

This menu can be accessed by selecting **Configuration** from the main menu. The table below lists options and descriptions for the *Configuration* menu.

Options	Description
GPS base station options	For using a land base station or beacon for real time corrections
NMEA/TSIP output	Consult manual
Coordinate system	Changes coordinate system among latitude/longitude, UTM, and other coordinate systems. System can be converted, if necessary, after data capture by using Pathfinder Office software.
Map Display options	Change layers, scale, background files and items shown on the TSC1 screen during data collection
Navigation options	Changes Navigation parameters
Units and display	Changes various units, for example: length (e.g., feet, meters), altitude reference (e.g., MSL), *North reference* (i.e., true or magnetic). Units can be converted, if necessary, after data capture by using Pathfinder Office software.
Time and date	Changes to *local time*, 24-hour clock, date format, and other options
Quickmarks	Set-up parameters for use with Quickmarks.
Constant offset	Set-up parameters for use with a constant offset.
External sensors	Connections with external sensors.
Hardware (TSC1)	TSC1 settings such as beep volume, contrast, *internal and external battery status*, software version, free space.

Contrast and Backlighting

The TSC1 display can be viewed in various light settings. Press **FUNC**, then **L** to turn on the display backlight for viewing in dim lighting. Adjust the contrast by pressing **FUNC**, then **E** or **F**.

ATTACHMENT 4
PRE-SAMPLING ACTIVITIES BEFORE USE OF THE PRO XRS

Determination of Optimal Satellite-Use Time

Positioning accuracies on the order of ±1 to 3 m can be achieved by avoiding the few minutes per day when the satellites are not providing the same level of signal. The GPS unit provides the operator with a listing of the time intervals during the day when accuracies are decreased. Avoiding these time intervals permits the operator to maintain better positioning accuracy.

ATTACHMENT 5
MANAGING GPS DATA FROM TERRASYNC—A TUTORIAL

Currently, positional data collected in the field is most often done with a Trimble GPS unit (usually rented) interfaced with a laptop via Trimble's Terrasync software. The Terrasync software sometimes exhibits quirks that interfere with the smooth operation of data collection in otherwise stressful field conditions. This tutorial is meant to supplement the Terrasync software documentation and serve as a guide to field personnel to help them retrieve and collect geographic data as efficiently as possible with existing software.

Scope

This document is intended to be a reference for procedures involving the following:

- Fixing files that are more than 7 days old so that they can be updated
- Adding features in GPS Pathfinder software (companion to Terrasync) and then importing them as base files in Terrasync..

This document is not intended to be a comprehensive manual for using Terrasync or Pathfinder software. It is assumed that the reader has received at least some training on how to use the basic features of Terrasync and is competent at using MS Windows.

The Basics

GPS data collection currently relies on two pieces of complementary software:

- Terrasync—the interface for GPS navigation and data collection.
- Pathfinder Office—a multiuse piece of software that acts as a conduit between GIS data files (shape files) and Terrasync GPS files. Pathfinder can also be used as a simple map editor.

Installing the Correct Versions of Terrasync and Pathfinder

Important Note: This tutorial uses Pathfinder Office v. 3.00 and Terrasync v. 2.50. It is very important to use the proper versions of this software to avoid compatibility issues. These software versions should be included in the same folder as this tutorial, or can be obtained from GIS staff.

http://www.trimble.com/terrasync_ts.asp?Nav=Collection-4576

Key code for TerraSync
499043-00110-05273-EDD049BC

Pathfinder v.3.00
001533-00300-04152-0ee4d11f

Initial Setup of Terrasync/Pathfinder

Certain settings and configuration setups are needed before Pathfinder can talk to Terrasync. Whether you are installing this software for the first time or have an existing installation, check to make sure that these settings are in place.

1. Open Pathfinder Office and go to the *Utilities>Data Transfer...* menu. A dialog box should appear. This is the interface for communicating with Terrasync.
2. Click the **Devices** button, and then **New...** (Figure 1).
3. Click on **GIS Folder**.
4. Browse to the Terrasync data folder on your computer, which in most cases will be *C:\My Documents\TerraSync*.
5. In the next box, *Type* will be **Terrasync**, and *Version* will be **v. 2.1x, v.2.2x, v.2.3x,** and **v2.4x**.
6. At the prompt for a name that will display in the device list, enter **Terrasync**.
7. Go back to the Data Transfer dialog box, select **Terrasync** from the dropdown menu, press the **Connect** icon, and look for a green check mark indicating success.

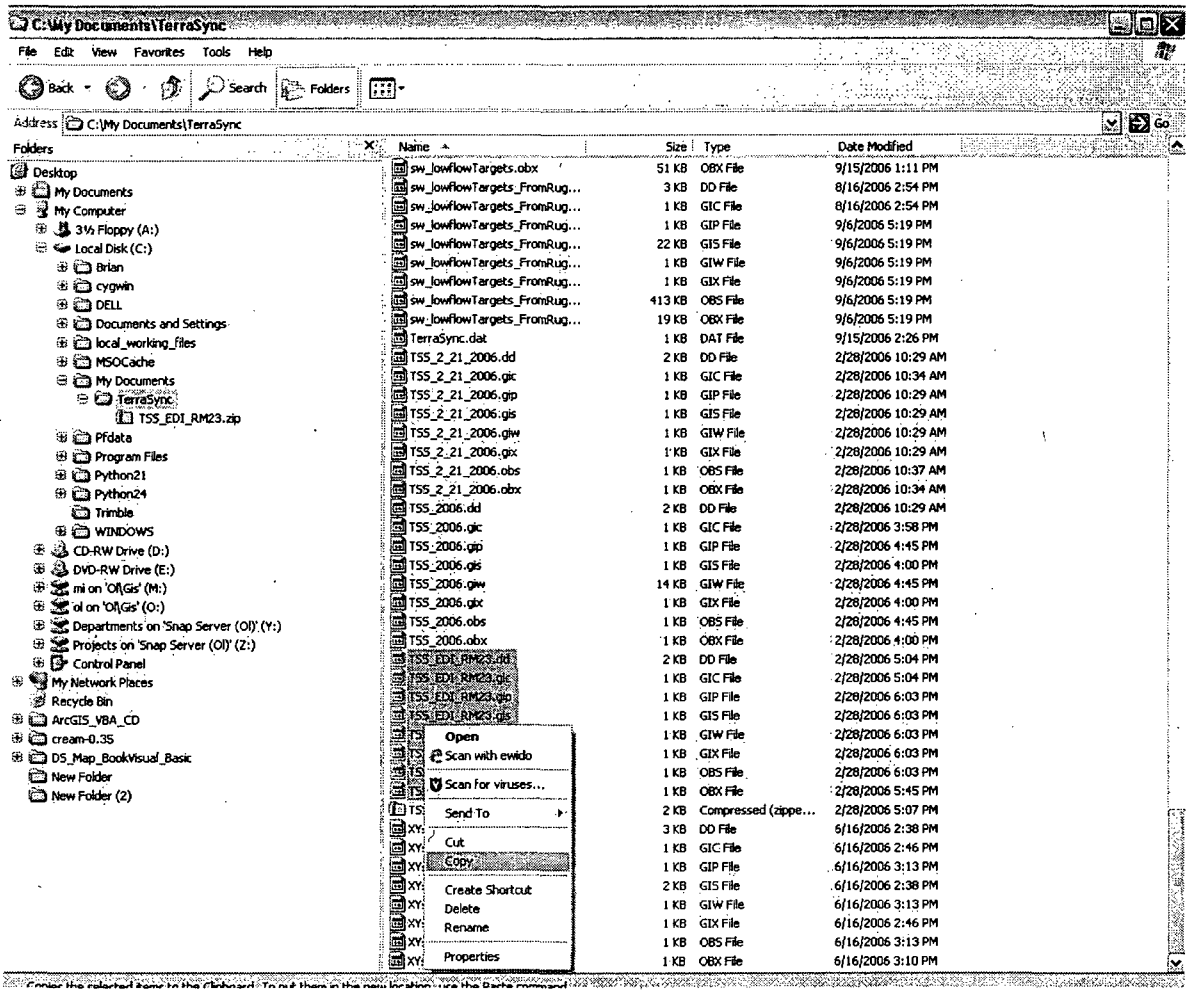


Figure 2. Selecting Files To Copy to a Different Directory

If this procedure does not work for you, you may have the wrong version of Pathfinder. For some unknown reason, with each version upgrade of Pathfinder, connectivity to older versions of Terrasync is lost. You can check what version of Pathfinder you have installed by going to the *Help>About GPS Pathfinder Office...* menu. To find out what version of Terrasync you have, go to *C:\Program Files\TerraSync*, right-click on **Terrasync.exe**, and choose the **Version** tab.

Handling Expired Files in Terrasync

One of the most common problems that field personnel will have to deal with is the 1-week expiration date when trying to collect data with Terrasync. This is a built-in function of Terrasync, and there is no simple way to work around it. The following instructions will guide you through the process to make the files usable. See Figure 3.

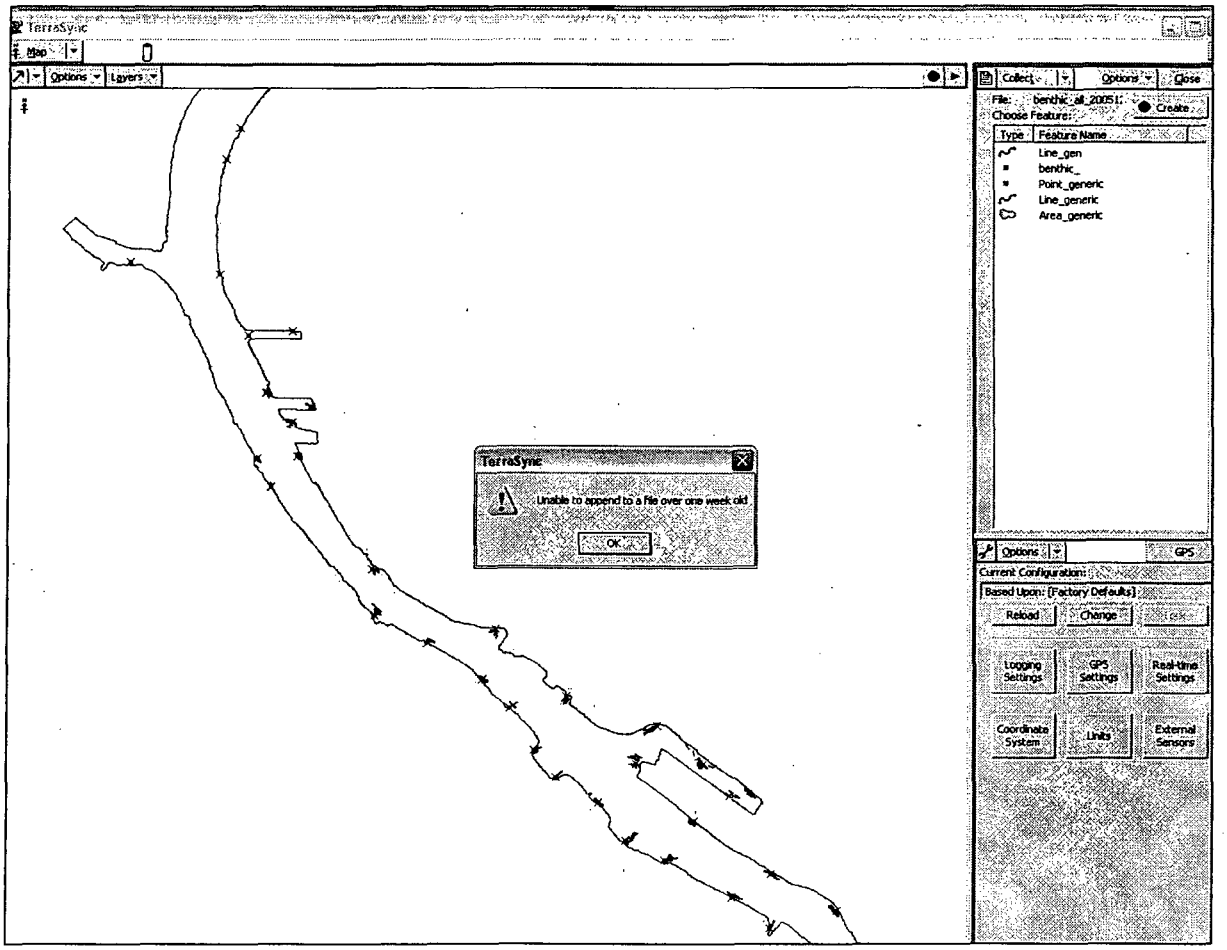


Figure 3. Notice That Terrasync File Older Than 1 Week Will Not Allow User To Collect Features (time begins to elapse when first feature is collected in the field, not when file is created)

Two options are available, depending on your needs. If you do not need to see the previously logged locations and need only to see the targets, use the original files provided by GIS staff (Option 1). If you need to see previously occupied locations in order to make decisions about where to go next, then transfer the file to Pathfinder and back again (Option 2).

Option 1: Move and replace logged files with original targets.

At the beginning of the field effort, you should receive a set of files with the target locations, most likely in a zip archive (.zip file extension). There will be six to eight files with the same name but with different extensions (Figure 4). These files will have to go into the *C:\My Documents\TerraSync* folder in order to be available to Terrasync.

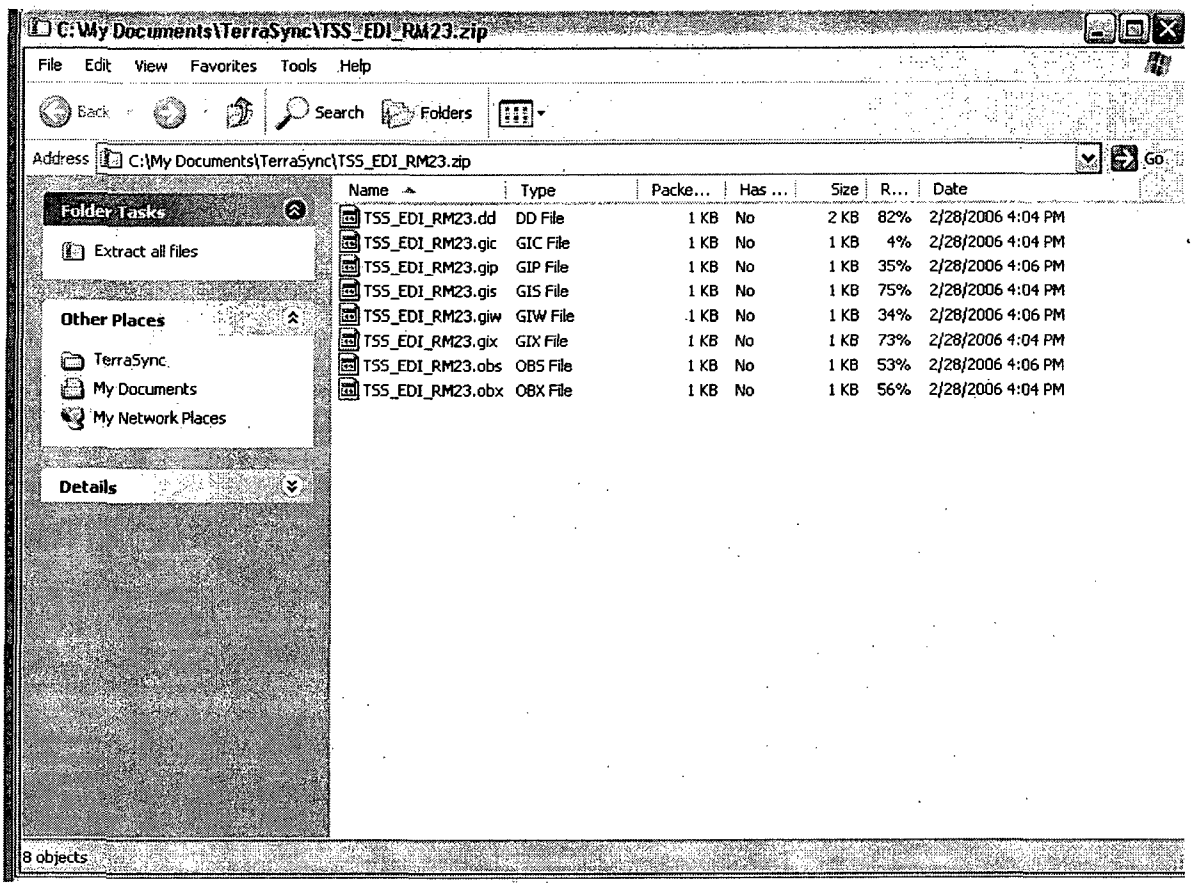


Figure 4. Example of File Set To Be Unzipped into the Terrasync Folder

After you unzip these files to Terrasync, keep this zip archive around in an easy-to-find place, such as your computer desktop, because the 1-week clock does not start until you begin collecting your first point in the field. You can use this unadulterated file again, as long as you make a copy of the work you did the previous week. The detailed steps are as follows:

1. Make sure you have the original files with the target locations available in a handy place. This will probably be the original zip archive. Also, be sure to close Terrasync while performing this process.
2. Navigate to C:\My Documents\TerraSync\ in Windows Explorer. Locate the files that you have been using the previous week. Note: It is crucial to get all of the small files associated with the data set. While it is useful to sort the files by date modified, you can miss some of the small files—it is highly recommended that you sort the files alphabetically.

3. Copy all of these files to a different directory, preferably one that is named appropriately to reflect the data and time period that you were collecting. For example: C:\Documents and Settings\bpointer\Desktop\lampreyTargets_20060925. These files contain the data you have collected the previous week and should be backed up and/or emailed to the appropriate project manager or GIS staff.
4. You can now safely replace the files you just copied with the ones from the original zip file. Right-click the zip archive, and click Extract All. When prompted to Select a folder to extract files to, browse to C:\My Documents\TerraSync. (Figure 5). If prompted about replacing existing files, select Yes to All. Note: It is crucial to make copies of the files first (see Step 3 above)—otherwise, you may lose the data.
5. You should now be able to open the file in Terrasync and begin logging as normal.

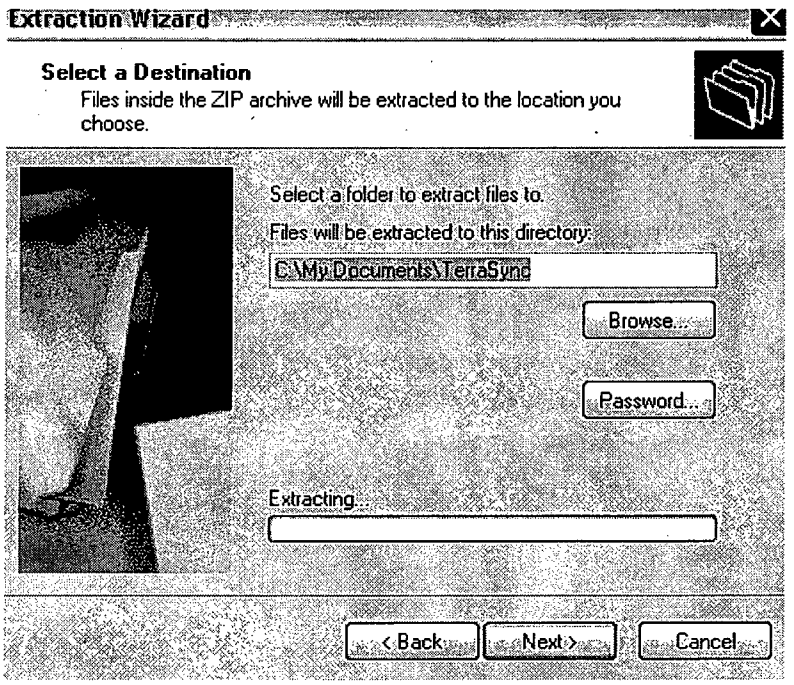


Figure 5. Extract (or copy) Original Target Files into the Terrasync Directory

Option 2: Transfer files back and forth from Terrasync.

If you need to be able to see the previously occupied positions from last week while positioning this week, you need to use Pathfinder to reset the file. This process will essentially combine the targets and actuals from last week into one file. However, this method has its drawbacks; once converted, the actuals from last week will not be able to be corrected, so a backup procedure similar to the one in the previous option should be carried out to maintain data integrity.

The steps for file transfer are as follows:

1. For good data management, back up the data files from the previous week using the procedure laid out in steps 1 through 3 in Option 1 above.
2. Close Terrasync and open up Pathfinder Office.
3. Go to the Utilities>Data Transfer menu or just click the icon on the left (Figure 6).
4. Ensure that the device listed is Terrasync. If not, follow the initial setup instructions at the beginning of this document. Most of the computers used for GPS logging are already setup for this.
5. There are two tabs, Receive and Send. Make sure that Receive is selected and then go to Add>Data File. Select the file(s) that you are using and select Open. The file should now be in the Files to Receive box. Click Transfer All and wait for the transfer to take place. If you have made the recommended backups, it is fine to replace any files.
6. Now select the Send tab (Figure 7), and go to Add>Data File. Select the file you just transferred (it will have the same name as the Terrasync file) and click Open. Now click Transfer All to move the file back to Terrasync.

   By transferring the file back and forth from Terrasync to Pathfinder, you have "reset the clock" and can now update the file for an additional 7 days. This file will have your targets and actual positions from the last week, so it is important to be aware of the features you are selecting for navigation.

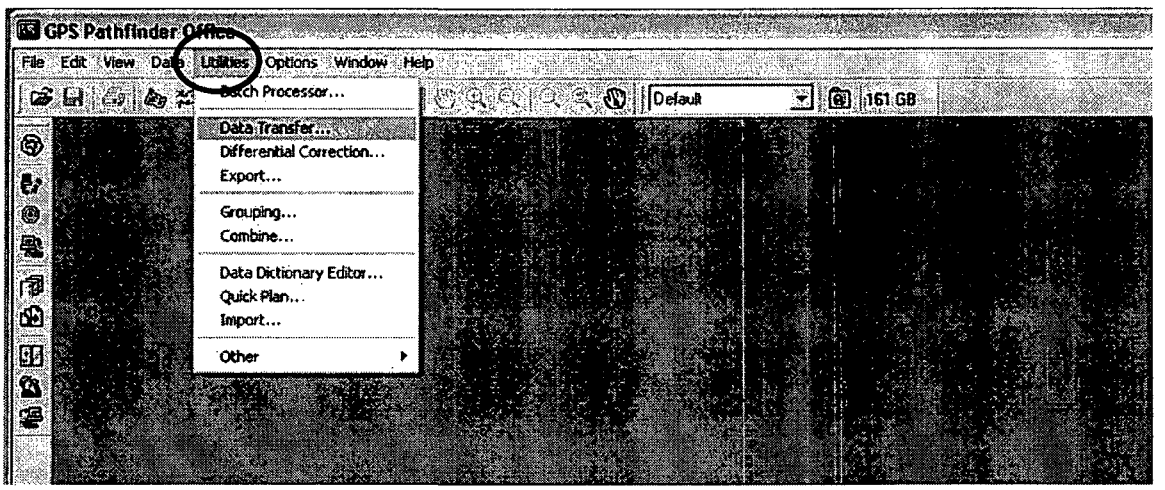


Figure 6. Data Transfer Menu

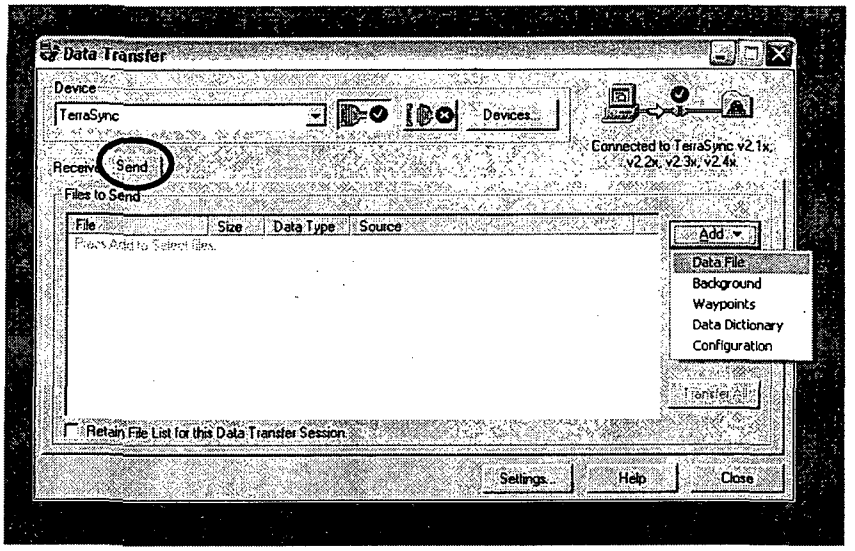


Figure 7. Sending Data File

integral consulting inc.

SEDIMENT POREWATER SAMPLING WITH SPME USING PDMS-COATED GLASS FIBER—METHOD DESCRIPTION

SCOPE AND APPLICATION

This document describes the method for collecting *in situ* sediment porewater samples and surface water samples using solid-phase microextraction (SPME). Porewater is defined as interstitial water within the sediment matrix, or water occupying the spaces between sediment particles (USEPA 2001). The equipment and methods described herein were developed for sampling porewater of the engineered cap at the San Jacinto River Waste Pits (SJRWP) for dioxins and furans, by Dr. Danny Reible at the University of Texas at Austin and others (Mayer et al. 2000; Gschwend et al. 2011; Lu et al. 2011), Integral Consulting Inc., and Anchor QEA LLC.

This method description was specifically developed for use in collection of information on concentrations of polychlorinated dibenzo-*p*-dioxins and dibenzofurans in porewater of the armor cap at the SJRWP site. Methods for preparation of the SPME fibers, their deployment, retrieval, and processing are described.

SUMMARY OF METHOD

Sediment porewater concentrations can be measured *in situ* using SPME sampling devices (Mayer et al. 2000; Fernandez et al. 2009; Lu et al. 2011). The technology discussed herein uses SPME sampling devices that consist of a glass fiber core coated with polydimethylsiloxane (PDMS; a polymer sorbent) placed in a modified piezometer casing. The casing allows for deployment directly into the sediment while avoiding physically damaging the fibers.

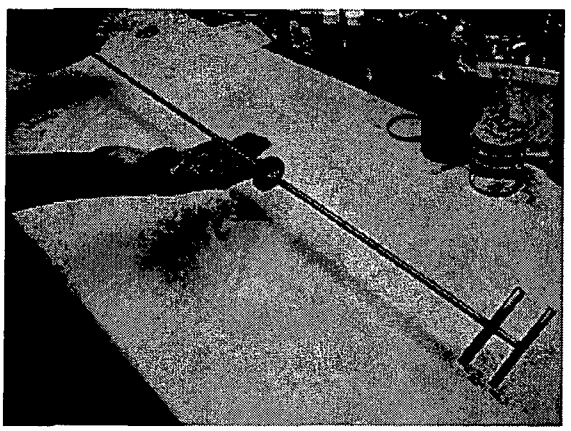
The SPME sampling device is placed into the sediment or cap material or exposed to surface water and left in place for approximately 30 days to allow target chemicals in the sediment matrix to equilibrate with the PDMS coating on the fiber. After the exposure period, the SPME sampling devices are retrieved and the PDMS-coated glass fibers are analyzed for concentrations of hydrophobic organic chemicals. The contaminant concentration that accumulates in the polymer sorbent at equilibrium is directly proportional to the dissolved contaminant concentration in the porewater. A proportionality constant, such as an octanol-water partitioning coefficient (Kow), or a polymer-water partition coefficient, if available (Lu et al. 2011), can be used to estimate the concentration of each chemical in the porewater sampled from the concentration in the PDMS coating.

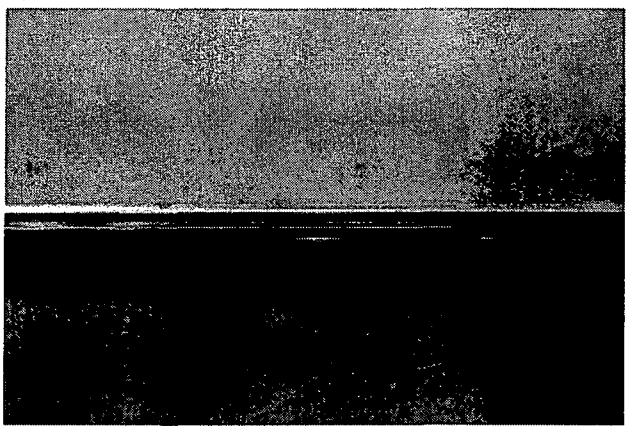
To measure or estimate concentration profiles of hydrophobic organic compounds in the porewater of the cap using PDMS-coated glass fibers, a field-deployable porewater profiling

apparatus will be used to deploy the SPME sampling devices directly into the coarse cap materials within a protective casing.

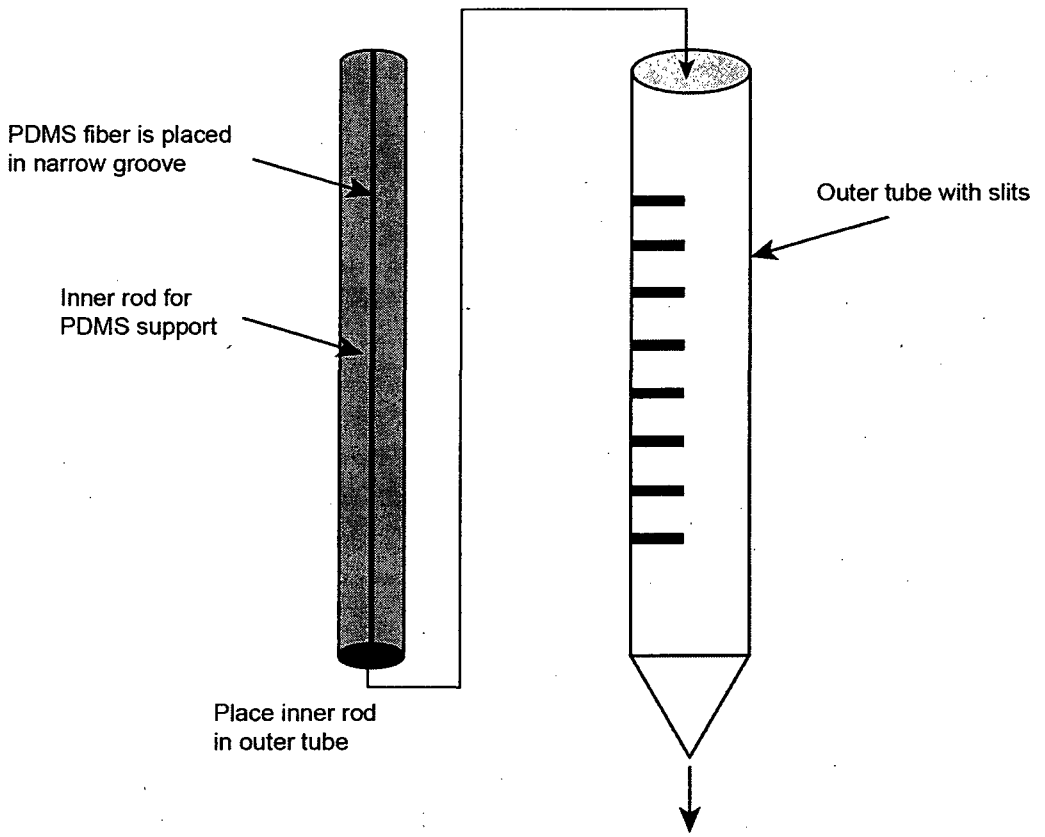
PDMS-coated fibers are the central element to this sampling method. These fibers are commonly used in optical applications. The fibers that will be used in this study will be 1000-μm-diameter fibers with a 35-μm coating of PDMS, which corresponds to about 115.5 μL of PDMS per meter of fiber. The fiber will be manufactured by Polymicro Technologies of Phoenix, Arizona, which produces the glass fibers with the PDMS coating. In production, they maintain quality control by regular measurement of fiber coating.

Prior to deployment, individual PDMS-coated glass fibers are placed into the inner rod of the sampler an approximately 2-mm-wide rectangular groove in the inner rod. This inner rod is placed into a protective case consisting of a piezometer with approximately 0.5-mm-thick slits cut at 6-mm spacing. These openings in the casing allow equilibration of the PDMS-coated glass fiber core with the sediment porewater during the study. The bottom and top of each rod will be sealed with silicone caulk to prevent an inflow of sediment through the system during deployment.





The SPME sampling device containing the PDMS-coated glass fiber is inserted into the modified piezometer rod, as shown below, to protect the fiber from potential mechanical degradation during installation into the armor rock cap.



Laboratory and Field Quality Control Samples

Quality assurance and quality control (QA/QC) samples will be collected in all major steps of this study. These samples will include the following:

- Samples collected during the preparation of the samplers to ensure that chemicals detected in samples after exposure in the field did not come from the original fibers themselves or from elements of the sampling apparatus such as caulk
- Samples collected during sampler deployment to ensure that contamination is not introduced during the transportation to and installation of the SPME sampling devices in the field
- Samples collected during sampler retrieval to ensure that contamination is not introduced during the procedures of collecting the samplers in the field
- Replicate samples to assess the variability of the results of samples in the field
- Preparation of materials to support laboratory internal quality control samples, including blank spikes, blank spike duplicates, and blank samples.

A summary of these QC samples is presented in Table 1. The details of QC sample preparation and collection are described in the appropriate section of the document below.

Table 1. Summary of Quality Control Samples

Study Stage	QA/QC Sample Types	Purpose	Frequency
Sampler Preparation	Caulk Blank	Ensure caulk used in samplers does not contribute tetrachlorodibenzo-*p*-dioxin (TCDD) and tetrachloro-dibenzofuran (TCDF) to final sample	1
	SPME Blank	Ensure fibers do not contain TCDD and TCDF prior to deployment	1
	Solvent Rinse Blank	Ensure that decontamination of samplers prior to deployment is effective	2
	Fibers for Laboratory QC	Provide materials for laboratory internal matrix-specific quality control	Three 5-cm long fibers
Sampler Deployment	Field Replicate Samples	Assess field variability	2
	Environmental Blank	Assess if air-deposited SPME contamination occurs during sampler deployment	1
Sampler Retrieval	Environmental Blank	Assess if air-deposited SPME contamination occurs during sampler retrieval	1
	Temperature Blanks	Ensure that samples maintain proper temperature	One per shipping cooler

SUPPLIES AND EQUIPMENT

Equipment required includes the following:

- Preparation
  - Glass fiber coated with PDMS
  - Sampling device, including the modified piezometer to serve as an external sheath
  - Sampler tags
  - Alconox®, Liquinox®, or equivalent industrial detergent

  - Performance reference compound (PRC) stock solution. PRCs for this study are ^{13}C-labeled tetrachlorodibenzo-*p*-dioxin (TCDD) and tetrachlorodibenzofuran (TCDF)
  - Hexane, pesticide grade or equivalent
  - Distilled water
  - Properly labeled squirt bottles
  - Polyethylene or polypropylene tub (to collect solvent rinsate)
  - Container tubes with caps on both ends, constructed from PVC or equivalent and large enough to carry assembled samplers before deployment and after retrieval
  - Drying oven
  - Kimwipes®
  - Waterproof caulk (hydrocarbon-free silicone)
  - Waterproof marker
  - Heavy-duty aluminum foil
  - Personal protective equipment as specified in the health and safety plan (e.g., nitrile gloves)
- Deployment
  - Dive boat (sampling vessel)
  - Diving gear (as stipulated by the dive company)
  - Prepared SPME sampling devices (modified piezometer)and auxiliary fiber holders for surface water samples, wrapped in foil and stored in appropriate containers
  - Differential global positioning system (DGPS)
  - Watch
  - Waterproof sample tags, waterproof marker, and cable ties
  - Hose clamps or zip ties to be used to attach the auxiliary surface water sampler to the primary SPME sampler at three locations
  - Sufficient line to extend from SPME to shore
  - Stakes and flagging tape to affix and mark SPME line on the shore
  - Buoys and tags (if unable to affix SPME line on the shore)
  - Personal protective equipment for field team (e.g., rain gear, steel-toed boots, nitrile gloves)
  - Health and safety plan

  - First aid kit
  - Cell phone
  - Rebar or equivalent (probe)
  - Logbooks, indelible blank-ink pens, and field forms
- Retrieval
  - Dive boat (sampling vessel)
  - Diving gear (as stipulated by the dive company)
  - Sample coolers and ice
  - Container tubes with caps on both ends, constructed from PVC or equivalent and large enough to carry assembled samplers before deployment and after retrieval
  - DGPS
  - Watch
  - Sample tags, waterproof marker, and cable ties
  - Heavy-duty aluminum foil
  - Personal protective equipment for field team (e.g., rain gear, steel-toed boots, nitrile gloves)
  - Health and safety plan
  - First aid kit
  - Cell phone
  - Logbooks, indelible blank-ink pens, waterproof markers, and field forms
- Processing
  - Kimwipes®
  - Deionized water (analyte-free; received from testing laboratory or other reliable source)
  - Heavy-duty aluminum foil
  - Ceramic column cutter
  - Ruler
  - Hexane, pesticide grade or equivalent
  - Auto-pipette, syringe, or other devices capable of delivering volumes of 1 mL and 2 mL
  - 2-mL screw cap auto-sampler vials, amber glass

- Waterproof marker
- Personal protective equipment as specified in the health and safety plan.

PROCEDURES

General Procedures

During all procedures discussed herein, the following general guidelines will be followed:

- Fiber samples will be handled with nitrile-gloved hands. At no point should skin contact fibers.
- Sampling and sample processing staff will endeavor to minimize the amount of time fiber samples are exposed to air to minimize the chance of cross contamination.
- The time, place, staff involved, and any deviations from this sampling plan will be rigorously documented in appropriate laboratory and/or field notebooks.

Preparation of Fibers and SPME Sampling Devices

Preparation of the SPME devices will take place in a laboratory prior to deployment in the field. As with all handing of fibers, clean nitrile gloves will be worn for all steps of the preparation process. The sampling devices (modified piezometers) will be disassembled and all surfaces of the individual pieces will be washed with Alconox® (or Liquinox®) and hot water. This wash will be followed by a sequential series of rinses of the pieces of the metal casing with hexane, acetone and distilled water, followed by drying in an oven overnight.

Using one sampler, after the apparatus has been dried, the metal rod that holds the PDMS-coated glass fibers inside the casing and the casing will be rinsed with hexane and the rinsate collected. In addition, prior to assembly of any samplers, all fibers will be rinsed with hexane, and the rinsate collected. This combined rinsate sample will be analyzed immediately and results obtained prior to deployment of samplers.[1] This rinsate will be analyzed as a solvent rinse blank for TCDD and TCDF. Staff preparing fibers will use sufficient volume of solvent to thoroughly rinse the sampling device, but not generate excess solvent.

Two types of fibers will be prepared: sampling fibers and PRC-impregnated fibers. Because the PRC is the same as the target chemical but is $^{13}C_{12}$-labeled, sample fibers will be deployed in separate deployment devices, in separate locations. Spatial segregation of the porewater samplers from samplers containing the PRC-impregnated fibers is necessary to prevent $^{13}C_{12}$-

[1] If it is not possible to collect and analyze a single rinsate blank for all fibers associated with the study, and to obtain results prior to deployment of samplers, rinsate blanks for individual fibers may be needed to ensure that each individual fiber is uncontaminated upon deployment. Individual rinsate blanks will allow investigators to address contamination of samplers on an individual sampler basis.

labeled compounds diffusing out of the PRC-impregnated fiber and being absorbed by a sample fiber directly adjacent to it. In this case, spacing between porewater samplers and the sampling device with the PRC should be at least 20 feet.

With 14 stations to be sampled and 4 PRC stations, the following fibers will be prepared:

- Sixteen sampling fibers for field samples at 14 stations with two replicates.
- Four PRC fibers for field samples.
- Two sampling and 2 PRC fibers for the backup samplers.
- Two sampling fibers and one PRC-impregnated fiber in casings appropriate for sampling surface water concentrations (i.e., above the sediments). This sampler will be attached to the end of a two-foot long sampler that extends above the sediment-water interface. A total of three surface water extensions will be deployed.
- One fiber for an SPME blank.
- One fiber for a deployment environmental blank sample.
- One fiber for a retrieval environmental blank sample.
- Three 5-cm PRC fibers to assess initial PRC concentrations.
- Three 5-cm sample fibers for laboratory QC samples.

Each sampling device will include one fiber, so the number of fibers that will be cleaned will equal the number of samplers to be assembled, plus the additional fibers prepared for QC samples.

The sample fibers are used to collect the porewater sample, while the PRC-impregnated fiber is used to indicate the fractional extent of equilibrium of the fiber with the sediment. The initial preparation of the fibers is the same. The PRC-impregnated fibers undergo the additional step of impregnation with performance reference compounds.

Prior to assembly, the PDMS-coated glass fibers will be cleaned by soaking in solvent overnight, with hexane as the solvent for the sampling fibers. As is standard throughout this procedure, the fibers will be handled using nitrile-gloved hands. After the PDMS-coated glass fibers have soaked overnight, the fibers will be rinsed with distilled water, and blotted dry with Kimwipes®. After cleaning, the fibers will be wrapped in aluminum foil and placed in a decontaminated container such as a modified PVC tube with caps on each end until the SPME sampling devices are assembled.

The PRC-impregnated fibers are prepared by spiking a known volume of the PRC reference stock solution (which will be mixed with a carrier such as methanol first) into a known volume of deionized water in a volumetric flask and mixing well (at least 10 full inversions), to produce a soaking solution with a specific concentration. The PDMS-coated glass fibers to be impregnated with PRC will be placed into a 5 cm by 1 m glass tube with screw cap ends with

Teflon sealed caps, and tumbled for 5 days. After tumbling, three 5-cm segments of the PRC-impregnated fibers will be analyzed to determine the PRC concentrations in the PDMS of the impregnated fibers.

The sampling devices themselves will be prepared after all the fibers are prepared. A cleaned sampling fiber, or fiber impregnated with the PRC, will be placed into the groove on the side of the inner rod of the sampler. To make sure the fiber is securely in place, a clean, nitrile-gloved finger should be run along the groove. Then, the entire inner rod will be inserted into the sampling device casing, and the casing will be affixed with approximately 1 cm of waterproof, hydrocarbon-free, silicone caulk at both ends. The caulk will serve to hold the fiber in place, and fill any gaps in the insertion tool, eliminating any vertical water movement. Silicone caulk shall not be placed anywhere on the screened length (i.e., the active measurement portion) of the insertion tool. The device preparer will also avoid placing excessive caulk that could hinder the insertion tool separation during sample retrieval and processing. One complete sampler will be rinsed with hexane and the rinsate collected as a second rinsate blank, to ensure that samplers are not contaminated prior to deployment.

Each of the samplers will be labeled with a unique sampler number using a waterproof marker on a waterproof tag attached to the SPME sampling device handle. The length of fiber loaded onto each sampling device will be documented to the nearest millimeter, and the length entered in the laboratory notebook for that sampler. Samplers containing a PRC fiber will be given a unique sampler number and will be clearly noted as such with a waterproof marker and tag on the deployment device. Once each sampling device has been loaded with the inner rod containing a sampling fiber or a PRC-impregnated fiber, the caulk will be allowed to dry for 1 hour. After assembly, each sampling device will be wrapped individually in aluminum foil and stored in a sealed container (e.g., modified PVC tube with caps) in a secure location prior to deployment.

Sample Custody and Shipping

Sample custody will be maintained in accordance with procedures outlined in Section 3.2 of the Field Sampling Plan (FSP) and detailed in SOP AP-03, *Sample Custody*. Samplers prepared and stored in the SPME laboratory will be documented on chain-of-custody (COC) forms, and maintained in a secure cooler at the laboratory prior to deployment. Upon deployment, COCs will be signed by the SPME laboratory into the custody of the Anchor QEA field lead. At the time of retrieval, a second set of COCs will be completed in the field, and used to document custody of samplers through analysis at the analytical laboratory.

Summary of Analytical and Quality Control Samples Developed during Sampler Preparation

The following analytical samples will be collected during sampler preparation:

- A caulk blank sample, consisting of a 1-g aliquot of the caulk used to attach the fibers to the sampling device in a glass jar.

- An SPME fiber blank sample. This sample consists of an SPME sampling device that is identical to the SPME sampling devices that are deployed in the field. Following preparation, the SPME blank will be stored in foil, placed in a sealed container and shipped to the analytical laboratory just prior to the field event. The SPME field blank will be stored by the analytical laboratory at 4±2°C. The SPME field blank will be analyzed at the same time as those that were deployed in the field.
- A solvent rinse blank sample of all sample fibers and a single cleaned apparatus prior to assembly.
- A solvent rinse blank of a fully assembled sampler collected prior to deployment.
- Three PRC-impregnated fibers for analysis of the initial PRC concentration in the fibers.

In addition to the samples sent to the laboratory, the following materials will be prepared for subsequent QC analysis:

- One fiber for a deployment environmental blank sample
- One fiber for a retrieval environmental blank sample
- Three 5-cm sample fibers for laboratory QC samples.

Deployment

In waters greater than ~1 m depth, deployment of SPME sampling devices will be done by trained, appropriately certified scuba divers. The divers will deploy the devices as described below.

When the diver reaches a station, the diver, assisted by sampling crew on the surface boat, will insert rebar or a similar metal rod of known length into the cap to determine the thickness of the cap at that location (taking care not penetrate the geotextile underlying the cap). The diver and surface crew will then measure the amount of "stick up" of the probe above the cap surface to determine the depth of penetration by subtraction. The field lead, or designee, at the surface will record the thickness of the cap in the field log. The penetration depth of the SPME sampling device placed at this sampling location will be approximately equal to the depth of the armored cap at that station, as measured by the probing device. .

Before the deployment of any SPME devices, the field team will shut off all petroleum-driven motors, and put on fresh nitrile gloves before handling the foil-wrapped, prepared SPME sampling devices. The prepared SPME sampling device will be removed from the airtight transportation container and the aluminum foil protective wrap will be removed. A second tag, in addition to the sampler number tag, will be affixed to the handle of the SPME sampling device with a cable tie. The tag must contain the following information:

University of Texas and Anchor QEA, LLC: D. Nangju

(281) 565-1133, ext. 201

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The SPME sampling device will be inserted along the surface of the cap probing device and perpendicular to the sediment surface by the diver, to a depth just above the geotextile membrane on top of the cap in locations were the geotextile base is present (see Figure A-3 of the FSP), taking care that the device does not penetrate the geotextile material. After the SPME sampling device is in place, the probing device will be gently removed and armor cap materials will naturally fill in any void space around the SPME device that may be left by the removal of the probe. The Armor Cap Material A material in the northwestern portion of the armored cap does not have a geotextile underlayment. In this area, the sampling device should be installed to the design depth of the armored cap in that area (12 inches), or until a significant textural change is felt at the base of the armor cap if that change is apparent before penetrating 12 inches. All sampling devices will be connected via nylon cording to stakes marked with flagging tape or to buoys that will serve as markers for their retrieval after the exposure period.

At all locations, the 2-foot SPME sampling device should be sufficiently long to extend above the cap surface–water interface. In two sampling locations and one PRC location, these will be deployed such that an auxiliary casing with a length of fiber for the water sample can be attached to the portion of the device that extends at least 6 inches above the cap surface. This auxiliary device will be attached to the sampler with decontaminated hose clamps, zip ties, or similar. This length of fiber will provide a sample that can be used to estimate the concentration of the TCDD and TCDF in the surface water, with all the fiber in the auxiliary device above the sediment–water interface. The following information will be recorded in the field logbook at the time of deployment for each deployment location:

- Date and time that the SPME sampling device was inserted into the cap
- Station number
- The sampler number assigned to the SPME sampling device in the preparation step
- The length of the SPME sampling device that was inserted into the cap at a given location
- Water depth
- Depth of sediment or cap material into which the sample is deployed
- Notation of any petroleum-driven motor watercraft being used in the area of the sampling vessel
- DGPS station location coordinates

- Photograph numbers for a specific station
- Information from the diver on the description of the area near the station (e.g., vegetation, debris, evidence of surface disturbance, organisms).

After deployment, the SPME sampling devices will be left *in situ* for approximately 30 days (see project-specific FSP).

Deployment Quality Control Samples

The following field QC samples will be collected in the field during SPME sampling device deployment and analyzed by the analytical laboratory:

- Field replicate samples are co-located with SPME sampling devices at two locations, and collected in an identical manner over the same exposure period to provide a measure of the field and laboratory variance, including variance resulting from sample heterogeneity. Field replicate samples will be prepared by deploying and collecting two completely separate SPME sampling devices from the same station and submitting them for analysis as separate samples. Samplers will be assigned unique sample numbers in the field and will not be identified as field splits to the laboratory.
- The environmental blank is prepared in the field to evaluate potential background concentrations present in the air during deployment.

  To prepare an environmental blank in the field, the foil is removed from a prepared SPME sampling device while at a sample collection site, the SPME is exposed to the ambient air during the time that the diver is underwater for the period of deployment of one sampler, and then resealed in the foil. The environmental blank is assigned a unique sample number on a tag affixed to the handle of the SPME sampling device according to the sample numbering scheme. The environmental blank will then be placed in a sealed container and taken or shipped to the analytical laboratory. The SPME environmental blank will be stored by the analytical laboratory at 4±2°C, and analyzed at the same time as those that were deployed in the field.

Field Measurements

A water depth measurement will be collected at every sampling location. The depth of penetration of the cap will also be recorded. There are no field measurements of the *in situ* environment required for this study.

Station Location Coordinates

Station locations for all field sampling will be determined using a DGPS. The accuracy to which the latitude and longitude of a station location is determined is specified in the FSP. The DGPS consists of two satellite receivers linked to each other by a VHF telemetry radio system. The receiver will be on the sampling vessel. Details on collection of accurate station coordinates can be found in SOP AP-06, *Navigation.*

Retrieval

After completion of the exposure period of approximately 30 days, the field team and the dive crew will return to each sampling location to retrieve the SPME sampling devices.

Once on station, all petroleum-driven motors will be turned off.

Once a sampler is located, it will not be disturbed until the location on the SPME casing of the sediment-water interface is marked by affixing a zip tie on the sampler at the sediment surface. The zip tie must be sufficiently firmly placed to remain in place until samplers are processed in the laboratory. The SPME sampling device will then be removed from the sediment surface by the diver and immediately transported up to the sampling vessel. SPME sampling devices from only one station will be collected before returning to the sampling vessel. Only one SPME will be collected and handled by the divers at a time.

Before taking the retrieved SPME sampling device from the diver, sampling personnel will put on a new, clean pair of nitrile gloves at each station. The tag affixed to the handle of the SPME sampling device will be checked to confirm the station number. If the tag is missing or illegible, a replacement tag with the sample ID will be attached to the sampler. The SPME will be immediately wrapped in aluminum foil and placed into a sealed container, and stored in coolers on ice at 4±2°C.

The following information will be recorded in the field logbook:

- Date and time that the SPME sampling device was retrieved
- Length of the sampler below the zip tie used to indicate the position of the cap surface upon retrieval by the diver
- Station number
- Sampler number
- Water depth
- Notation of any petroleum-driven motors watercraft being used in the area of the sampling vessel
- DGPS station location coordinates
- Photograph number for a specific station
- Information from the diver on the description of the area near the station (e.g., vegetation, debris, evidence of surface disturbance, organisms).

Field Quality Control Samples

Details on collection of field quality control samples (e.g., field replicate SPME sampling devices) are specified in the project-specific FSP and above. At a minimum, the following field

QC samples will be collected in the field during SPME sampling device retrieval and analyzed by the analytical laboratory:

- An environmental blank will be collected during sample retrieval. The environmental blank will be prepared in the field by removing the foil from prepared SPME sampling device while at a sample collection site, exposing the SPME during the time that the diver is underwater, and then resealing it in the foil. The environmental blank will be assigned a unique sample number on a tag affixed to the handle of the SPME sampling device. The foil-wrapped environmental blank will then be placed in an appropriate closed container and taken or shipped to the analytical laboratory. The SPME environmental blank will be stored by the analytical laboratory at 4±2°C. The SPME environmental blank will be analyzed at the same time as those that were deployed in the field.
- Temperature blanks will be used by the laboratory to verify the temperature of the samples upon receipt at the testing laboratory. Temperature blanks will be prepared at the testing laboratory by pouring distilled/deionized water into a vial and tightly closing the lid. The blanks will be transported unopened to and from the field in the cooler with the sample containers. A temperature blank shall be included with each sample cooler shipped to the testing laboratory.

Field Measurements

A water depth measurement must be collected at every sampling location during sample retrieval.

Station Location Coordinates

Station locations for all field sampling will be confirmed during sample retrieval using a DGPS. Details on collection of accurate station coordinates can be found in SOP AP-06, *Navigation.*

Sample Custody and Shipping

Sample custody will be maintained in accordance with procedures outlined in SOP AP-03, *Sample Custody*. Upon retrieval, a second set of COCs will be prepared by the Anchor QEA field team, and will accompany the samplers the transfer to the analytical laboratory. All samples will be packaged and shipped (or may be delivered by courier) in accordance with procedures outlined in SOP AP-01, *Sample Packaging and Shipping*.

Processing

SPME processing will take place at the analytical laboratory. The SPME sampling device will be dismantled and the fiber carefully removed from the inner rod using nitrile-gloved hands. Each fiber will then be rinsed with deionized water and placed on a foil-covered surface. During this process, laboratory staff will take care to keep track of the position of the sediment–water

interface on the sampler casing. If the fibers are broken at the time of removal, the sample handler will maintain the relative vertical position of the pieces. The overall length of the fiber recovered will be documented to the nearest millimeter in the laboratory bench sheet or log book, including notation of any missing pieces or broken fibers. Each fiber will be rinsed thoroughly with deionized water.

For each depth interval to be sampled, one 2-mL auto-sampler vial will be prefilled with 2 mL of hexane. These vials will be labeled with a waterproof marker noting the solvent and volume used. If the samples are prepared at the analytical laboratory, the laboratory blank will be prepared using the same solvent as is placed into the vials.

A ceramic column cutter will then be used to section the fiber from each location into 5-cm lengths at the depth intervals specified in the FSP. The 5-cm lengths will then subsequently be cut into to 1–2 cm segments, and these segments placed into the prefilled 2-ml amber auto-sampler vial. Between each cut of fiber required for a unique sample (within a given sampling device), the ceramic column cutter will be decontaminated.

Each complete 5-cm sample will be placed into a vial pre-filled with 2 mL of hexane. The cap on the vial will be sealed and, using a waterproof marker, labeled with the sample ID, date and time the sample was processed, and the analysis to be conducted; this information will also be noted on the laboratory bench sheet or logbook. The meniscus of the solvent will be marked on the vial with a waterproof marker.

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Lu, X., A. Skwarski, B. Drake, and D. Reible, 2010. Predicting bioavailability of PAHs and PCBs with porewater concentrations measured by solid-phase microextraction fibers. *Environ. Toxicol. Chem.* 30(5):1109–1116.

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USEPA. 2001. Collection of interstitial water. In: Methods for collection, storage and manipulation of sediments for chemical and toxicological analyses--Technical manual: U.S. Environmental Protection Agency, Office of Science and Technology, Washington, DC.

ATTACHMENT A3
FIELD FORMS

CHAIN OF CUSTODY FORM

Project: _____

Samplers: _____

Integral Contact: _____

Office _____

Phone _____

Ship to:

Lab Name _____

Address _____

_____

_____

Contact _____

Phone _____

integral consulting inc.

Sample No.	Date	Time	Matrix	ANALYSES REQUESTED								Extra Container	Archive	Comments

Analysis Turn Time: Normal Rush **Rush Results Needed By:**

Shipped by: **Shipping Tracking No.**

Condition of Samples Upon Receipt: **Custody Seal Intact?**

Matrix Code:
GW - Groundwater
SL - Soil
SW - Surface water
SD -Sediment
Other:

Relinquished by: _____ *(signature)* **Date/Time:** _____ **Received by:** _____ *(signature)* **Date/Time:** _____

Relinquished by: _____ *(signature)* **Date/Time:** _____ **Received by:** _____ *(signature)* **Date/Time:** _____

Special Instructions:

Annapolis
200 Harry S. Truman Pkwy
Suite 330
Annapolis, MD 21401

Denver
285 Century Place
Suite 190
Louisville, CO 80027

Portland, Oregon
319 SW Washington St
Suite 1150
Portland, OR 97204

Honolulu
3465 Waialae Ave
Suite 380
Honolulu, HI 96816

Seattle
411 1st Ave S
Suite 550
Seattle, WA 98104

Portland, Maine
45 Exchange St
Suite 200
Portland, ME 04101

Olympia
1205 West Bay Dr NW
Olympia, WA 98502

CUSTODY SEAL

integral consulting inc.

*Date:*_____ *Time:*_____

Sampler Signature: _____

CORRECTIVE ACTION RECORD

Page ____ of ____ Audit Report No.: _____ Date: _____

Report Originator: _____ Person Responsible for Response: _____

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: _____ By: _____

Date of Actual Occurrence: _____ By: _____

Analyte: _____ Analytical Method: _____

Cause of Problem:

CORRECTIVE ACTION PLANNED:

Person Responsible for Corrective Action: _____ Date of Corrective Action: _____

Corrective Action Plan Approval: _____ Date: _____

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Person Responsible for Follow-up Activities: _____ Date of Follow-up Activity: _____

Final Corrective Action Approval: _____ Date: _____

APPENDIX B
LABORATORY QUALITY ASSURANCE MANUALS AND STANDARD OPERATING PROCEDURES